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New Zealand Geographer

VOLUME X April, 1954 NUMBER 1

NEW ZEALAND ANTARCTICA*

FRANK A. SIMPSON

ON 30 July 1923 His Majesty King George V, acting on the advice of his Privy Council and in exercise of powers vested under the British Settlements Act of 1887, ordered that 'that part of His Majesty's dominions in the Antarctic seas which comprises all the islands and territories between the 160th degree of east longitude and the 150th degree of west longitude which are situated south of the 60th degree of south latitude shall be named the Ross Dependency' (*Fig.* 1). The Governor-General of New Zealand was to be its governor,[1] and the order was to become effective 'from and after the publication of this Order in the Government *Gazette* of the Dominion of New Zealand'; which event took place on 16 August 1923.[2]

In what follows no attempt is made to examine all the many facets of the Ross Dependency. It will be immediately apparent that much

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* The author wishes to acknowledge the advice and assistance of Professor N. E. Odell, Dr. R. A. Falla, Dr. C. A. Fleming and Mr. H. W. Dawbin during the compilation of this article.

[1] The fact that the order placed responsibility upon the Governor-General, and not the Government of New Zealand as such, led to the following explanation by the attorney-general, Sir Francis Bell, in answer to a question in the Legislative Council on 15 August 1923: 'The boundaries of the Dominion of New Zealand [he said] had not been extended to include the Ross Sea and the land adjacent thereto. His Majesty's delegation under the Act of 1887 did not confer upon the Government or Parliament of New Zealand the same powers as were vested by the Constitution Act in respect of the Dominion itself. It might be assumed that His Excellency the Governor-General, in his administration of the Ross Territory, would invite advice from his Ministers of the Dominion, and it was certain that the details would be entrusted to the Departments of the New Zealand Government. But His Excellency was required, in all matters of legislation and regulations for the Ross Territory, to comply with instructions from His Majesty, transmitted through the Secretary of State for the Colonies. There was no reason to believe that the Colonial Office would give such instructions without prior consultation with the Government of the Dominion. The part which the Government of New Zealand has agreed to take in thus enabling His Majesty to exercise jurisdiction in and over the Ross Territory must be so taken on behalf of the Empire as a whole, and not specially in the interests of New Zealand. Our powers and duties would be entrusted to us under the British Settlements Act, as distinct from those conferred upon us under the Constitution Act.' (See *New Zealand Parliamentary Debates,* Vol. 202, 1923, p. 81.)

In effect the administration of the territory has been carried out and is being carried out along the lines suggested by the attorney-general in 1923; that is, the Government of New Zealand assumes administrative responsibility and delegates authority where necessary to departments of the government. This situation explains references to the Ross Dependency as a 'New Zealand' dependency; or, as the title of this article reads, 'New Zealand Antarctica', meaning that portion of the Antarctic regions which is under administrative control of New Zealand. The expression 'New Zealand Antarctica' also serves to draw a distinction between New Zealand antarctic and New Zealand subantarctic territory; the subantarctic territory being the southern extension of the dominion through the subantarctic islands to latitude fifty-three degrees south (in terms of a decision of the Imperial Government in 1863), while the antarctic territory is the Ross Dependency.

[2] *New Zealand Gazette,* Vol. II, 1923, pp. 2211-2212.

escapes mention, or is mentioned only in passing—meteorology and climatology, the aurora australis, the pack ice and other ice forms, currents and tides, navigational and transport problems, habitability, faunal relations, and so on. A consideration of all such questions in a single comprehensive survey must await a more ambitious enterprise than the present paper.

Continent, Shelf Ice and Offlying Islands

The area south of sixty degrees south, and between 150 degrees west and 160 degrees east, comprises about 160,000 square miles of land,[3] about 130,000 square miles of permanent shelf ice, and about 1,500,000 square miles of sea and ocean. The actual dependency, however, embraces only the 'islands and territories', as the text of the originating order puts it; or, as the preamble to the same order reads, 'the coasts of the Ross Sea, with the islands and territories adjacent thereto': which expressions presumably mean the land portion only, though to this must be added the coastal waters covered under the 'three-mile principle' of general international usage.

Although land forms a relatively small proportion of the region, its area is considerably greater than that of New Zealand itself (103,736 square miles) and greater also than the combined areas of New Zealand and its northern island territories (105,072 square miles). The question arises whether the permanent shelf ice extending out from the land in many parts of the dependency should be regarded as 'territory'. From the point of view of practical antarctic travel and the establishment of expedition facilities, the shelf ice has assumed the reality of land, and it would not be unreasonable to regard it, for administrative purposes, in the same category as the land of which it is a *de facto* extension. In these circumstances the base line for determining the three-mile belt of territorial water would presumably be the edge of the shelf ice.[4]

Apart from a few outlying islands,[5] the land within the dependency is the coastal fringe of the great Ross Sea indentation of the Antarctic continent. This coastal fringe includes numerous offlying islands, many of which are linked to the mainland by permanent ice. The western boundary of the continental coast runs from Oates Land through Victoria Land to the South Pole; and the eastern boundary runs

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[3] This figure is usually quoted as 175,000 square miles (see, for example, recent issues of the *New Zealand Official Year-Book*). Calculations from latest authoritative maps suggest a more modest figure of approximately 160,000 square miles.

[4] Ice features are recognised in Chile's definition of its Antarctic territorial claims. Decree No. 1747 of 6 November 1940, issued by President Aguirre Cerda, reads: 'All lands, islands, islets, reefs of rocks, glaciers [pack ice], already known or to be discovered. . . .' (Trans. in E. W. Hunter Christie: *The Antarctic Problem,* London, 1951, p. 281.)

[5] In this text 'outlying islands' are those more than 100 miles from land or ice coast; 'offlying islands' are those less than 100 miles from the coast. The distinction, though arbitrary, is convenient for the purposes of general description.

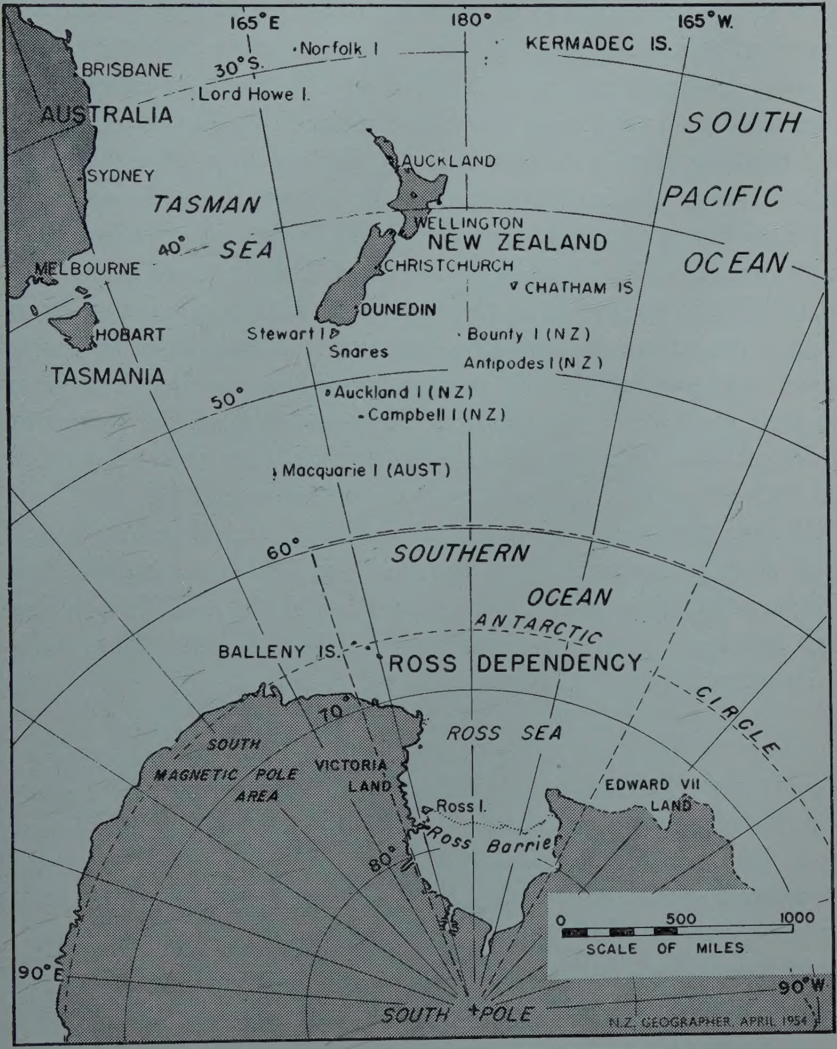

Fig. 1. New Zealand and the Ross Dependency.

from King Edward VII Land to the pole. We may thus consider the continental portion of the dependency in terms of two flanks converging at the South Pole—a western and an eastern flank which could perhaps best be identified respectively as the Victoria Land flank and the King Edward VII Land flank.

The poleward convergence of these two flanks lies on the continental plateau nearly 10,000 feet above sea level where the depth of ice is believed to be between 1000 and 5000 feet—one authority has suggested 7000 feet in places. This gigantic ice cap, spread over a vast area, presses northwards and downwards towards the sea (*Fig.* 2). In some parts of the continent the ice approaches the sea in wide fronts, but elsewhere this is not possible because of obstructing mountains. The greatest of these obstructions is the chain of mountains running for more than 1000 miles along the western coast of the Ross Dependency and reaching heights exceeding 10,000 feet above sea level. On the inland side of this mountain barrier the plateau ice banks up in an accumulation greater even than that at the South Pole, forming what is known as the Ice Crest or Ice Divide. On the seaward side of the barrier the mountains run steeply down to sea level, and here numerous glaciers pour from valleys and passes, and send tongues of ice many miles to seaward of the land coast, or out on to the shelf ice. Some of these glaciers are composed of highland ice from the mountain divide, while others carry ice from the main continental polar cap which has found a way through gaps in the mountain barrier.

The great mountain ranges and the imposing glaciers of the Victoria Land flank present one of the most majestic sights in Antarctica, but this grandeur is tempered on the King Edward VII Land flank where high mountains give way to knolls, nunataks and undulations which rarely exceed 4000 feet in height.

Coast and Shelf Ice

Only about one quarter of the continental coast of the dependency is bounded by sea (with local fringes of shelf ice). This is the case from Oates Land to Ross Island on the Victoria Land flank, and also on a small portion of the northern coast of King Edward VII Land on the opposite flank. The remaining three-quarters of the coast—from Ross Island southwards, then eastwards and northwards to the base of the peninsula of King Edward VII Land—runs along the shelf ice of the Ross Sea.

Ross Island, which marks the point where sea gives way to permanent ice on the Victoria Land flank, is itself permanently ice-bound on the south coast, but the strait, McMurdo Sound, which separates it from the mainland to the west, is navigable in summer months. Ross Island is the site of the loftiest active volcano in the Antarctic—Mount Erebus, 13,200 feet.

The Ross Shelf Ice forms a permanent link between Ross Island and

King Edward VII Land. Smaller areas of shelf ice are found in various parts of the dependency, notably in Lady Newnes Bay and Terra Nova Bay on the Victoria Land flank, and Sulzberger Bay on the northern coast of the King Edward VII Land flank. The Ross Shelf Ice, 400 miles from east to west and 400 miles from north to south, is the largest known mass of floating ice in the world, though it is not entirely free-floating, there being points at which it appears to be aground, or obstructed or supported by shoals and islands.[6] One

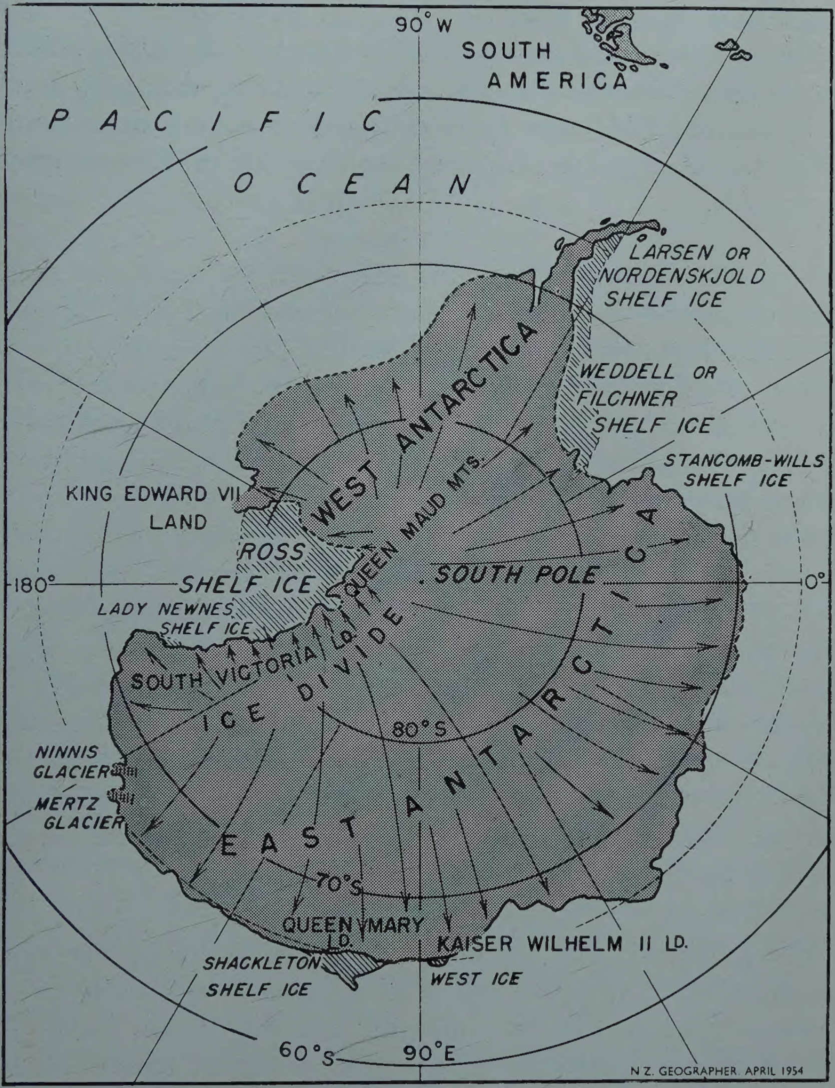

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Fig. 2. Major features of antarctic ice sheets (after L. M. Gould and N. E. Odell).

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[6] N. E. Odell: 'Antarctic Glaciers and Glaciology', in Frank A. Simpson (Ed.): *The Antarctic Today*, Wellington, 1952, p. 39.

of these islands, Roosevelt, is ninety miles long and forty wide, with its northern coast three miles south of the head of the Bay of Whales, a natural harbour in the shelf ice. The seaward face of the shelf ice, known as the Ross Barrier, or more simply, 'the Barrier',[7] ranges in height from six to 160 feet.

The Ross Barrier and the Ross Shelf Ice have been the starting points for all successful attempts to reach the South Pole, whether by land or by air. The British used the Ross Island area on the extreme west, while Amundsen and the Americans chose the Bay of Whales on the eastern side.

OUTLYING ISLANDS

The only islands more than 100 miles from the continental land coast or the shelf-ice coast are Scott Island and the Balleny Group. Scott Island, 350 miles northeast of Victoria Land, is a small islet a quarter of a mile long, 200 yards wide, 128 feet high, and normally ice-covered. Although the cliffs are precipitous there are several small beaches. The Balleny Islands consist of three islands and several islets. Young Island, the northernmost, is nineteen miles long and rises to 12,000 feet at Freeman Peak which has been reported, without confirmation, as an active volcano. Buckle Island, thirteen miles long, rises to 2440 feet. Sturge Island, the southernmost and largest of the three main units of the group, is twenty-seven miles long and eight wide, rises to 5000 feet, and has steep rocky cliffs with broad ice tongues on the coast. Of the islets, the principal are Row (half a mile long and 600 feet high) and Borradaile (two miles long and 1020 feet high). The Balleny Islands lie partly north and partly south of the antarctic circle; all the remaining land in the Ross Dependency is south of the circle.

GEOLOGY AND STRUCTURE

In a geotectonic sense the Antarctic continent is divided into two provinces—East Antarctica and West Antarctica, respectively two-thirds and one-third of the continental area. (See Figures 2 and 3.) East Antarctica includes the Victoria Land flank of the Ross Dependency, and West Antarctica the King Edward VII Land flank. The broad differences in the structure of the two flanks can therefore be found in a comparison of the broader geotectonic provinces into which they fall.

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[7] The term 'the Barrier' is sometimes used to describe the entire Ross Shelf Ice, not only the seaward face. Variations of 'the Barrier' are 'the Great Barrier', 'the Great Ice Barrier', and 'the Ross Ice Barrier'.

West Antarctica consists of fold ranges, plateaus and basins of post-Archean origin, for the most part corresponding to Mesozoic and Tertiary geosynclines and subsequent fold belts.[8] These have been traced from the southern Andes to the mainland of Graham Land, and in recent years have been followed across to Marie Byrd Land which adjoins King Edward VII Land. East Antarctica, on the other hand, consists of pre-Cambrian and overlying horizontal sedimentary rocks, forming what is known as the Great Antarctic Shield, extending from Coats Land eastwards to Victoria Land and embracing the main plateau of Antarctica and the South Pole (*Fig.* 3).

THE ROSS-WEDDELL GRABEN

A belt of subsidence, roughly 500 miles broad and 2000 miles long, runs between the Ross and Weddell Seas, more or less separating East and West Antarctica, and known as the Ross-Weddell Graben. It has been suggested that the graben might, in fact, be a strait dividing Antarctica into two subcontinents, one of which would contain the Victoria Land flank of the Ross Dependency and the other the King Edward VII Land flank. Some authorities are convinced there is no strait, but others prefer to leave the question open.

Granites, granodiorite and quartzdiorite from the West Antarctica sector of the Ross area have been described as similar to those of Queen Maud Range in Victoria Land. Biotite-hornblende granite has also been found. Collections of the Byrd expeditions have demonstrated metamorphosed sediments intruded by granite batholiths, the petrographical reports on which indicate a general similarity to the sodium-potassium-rich province of Victoria Land rather than to the calcium-magnesium-iron-rich province of West Antarctica generally. The King Edward VII Land suite correlates best with the pre-Cambrian of Victoria Land, while adjoining Marie Byrd Land presents an association of rocks best matched in the Paleozoic-Mesozoic-Andean geosynclinal rocks of Graham Land and the Scotia Arc.[9]

The geological column for the Victoria Land flank of the dependency has been set out as follows: Recent low-level moraines, high-level moraines, basalts; Pliocene palagonite tuffs, limburgites, kenytes, phonolites, tracytes; Cretaceous quartz dolerites; Lower Mesozoic-Upper Paleozoic beacon sandstone formation; Middle Paleozoic plutonic rocks, pink and grey granites; Lower Paleozoic slate-greywacke formation; and pre-Cambrian metamorphic rocks, crystalline limestones and schists.[10]

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[8] R. W. Fairbridge: 'The Geology of the Antarctic', in Simpson: *op. cit.*, p. 57.

[9] *Ibid.*, pp. 85-87.

The metamorphic series form the basement rocks of the region and cover considerable portions of it. The hiatus between these rocks and the slate-greywacke was probably a period of uplift and erosion followed by slight depression and deposition. The sands and clays which were then deposited have subsequently been altered to the greywackes and well-cleaved slates which make up the slate-greywacke formation along the coast near the northern end of Victoria Land. The plutonic rocks consist mainly of grey and pink granites and have a wide distribution. They are younger than the slate-greywacke series and older than the beacon sandstone, the latter being widely distributed and composed mainly of quartz derived from granite and cemented with iron-stained silica. Within the beacon sandstone, coal measures have been found in the Beardmore Glacier area and also 1500 miles away in King George V Land. There are also extensive seams between these two areas, fossils from which suggest a one-time more genial climate than that at present.

VULCANICITY AND GLACIATION

Another hiatus, probably a period of erosion and slight folding, was followed by the intrusion of great sills of quartz dolerites. Then a period of erosion, followed by fracturing and foundering, led to a volcanic period. This carries the geological history to the present day. Volcanic rocks form most of the islands of the Ross Sea, extend from Cape Adare to Cape Washington on the mainland, and cover a large area in the neighbourhood of Mount Discovery. Moraines stranded more than 1000 feet above the present low-level moraines have been seen in many places on Mount Erebus and on the mainland opposite the mountain, suggesting a general progressive retreat of the ice.

The outer margins of the Antarctic continent are considered to be abnormally low in contrast to the elevated interior. The continental shelf, which varies in width from about twenty to 300 miles, has its outer limits at 300-500 fathoms, instead of the 'normal' 50-100 fathoms. Seaward subsidence thus appears to be more developed than elsewhere. The broad embayment of the Ross Sea is not a deep gulf but a shelf sea, reaching 700 miles from the outer edge of the shelf. Towards its outer edge the continental shelf rises locally in a series of important

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[10] H. T. Ferrar: 'The Geological History of Ross Dependency', *Journ. Sci. & Tech.*, Vol. 7, 1925, pp. 354-361.

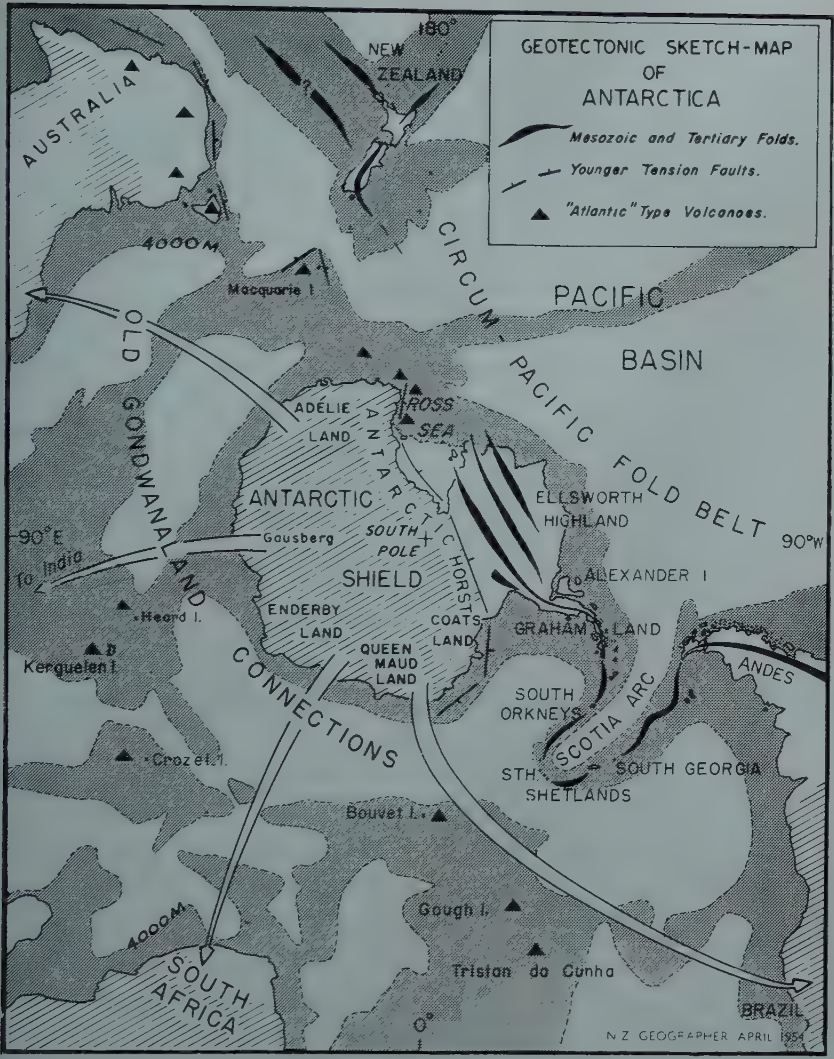

Fig. 3. Geotectonic sketch map of Antarctica (after R. W. Fairbridge).

elongate morainal banks which include the Pennell Bank at the entrance to the Ross Sea.[11]

The various shoals and submarine banks scattered around the shores of the continent are 'at least suggestive evidence' to support the hypothesis that, at its culmination, the main continental ice sheet may have encroached upon the continental shelf, and possibly at that time, by the process of erosion, laid down a basal moraine.[12] Submarine sounding and sampling have shown that such features as the Pennell

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[11] Fairbridge: *op. cit.*, p. 61.

[12] Odell: *op. cit.*, pp. 52–53.

Bank consist, at any rate in part, of mixed rock debris of morainal type that must have been derived from the inland mountains. In addition, analyses of the bottom-deposits of the Ross Sea, and of the peripheral region of Antarctica in general, have shown that the type of sediment is unique among marine deposits, and that it has all the characteristics of a glacial till.

NATURAL LIFE

The Ross Dependency provides no sustenance for any form of land animal, but the adjoining seas are relatively rich in organic life and provide food for a considerable population of birds, seals and whales.

Twelve species of birds, apart from penguins, have been reported in the area—the McCormick skua gull, giant fulmar, snow petrel, Wilson storm petrel, cape pigeon, antarctic fulmar (silver-grey petrel), antarctic petrel, arctic tern, antarctic whale bird, sooty albatross, black-browed albatross and gadfly petrel. The McCormick skua, giant fulmar, snow petrel and Wilson storm petrel have the most southerly range—as far south as the Barrier. These four species are also found in the open Ross Sea, together with cape pigeons, antarctic fulmars, antarctic petrels, arctic terns, and antarctic whale birds. All these birds, as well as the gadfly petrel, may be seen in the pack ice at the approaches to the Ross Sea, while on the northern outskirts of the pack there are also sooty albatrosses and black-browed mollymawks.

Most of the seabirds breed on the continental coast or islands south of the antarctic circle, but several also breed in Subantarctica. The giant fulmar, in spite of its southerly range, nests only in Subantarctica. Another three species—the white-headed petrel, blue petrel and sooty shearwater—are in a marginal category, for although they frequent the northern approaches to the territory—between fifty-five and sixty degrees south—they do not appear to be regular visitors south of latitude sixty.

The circumpolar antarctic penguins, the emperor and the adelie, both breed within the Ross Dependency. The emperor, the largest known living penguin, breeds at the southernmost limits of the sea ice in winter, while the adelie, a medium-sized species, breeds on ice-free portions of the continent and islands in the summer, and in winter keeps to the northern edges of the pack. The emperors lay their eggs in the dead of the antarctic night—July—and the chicks are hatched in the coldest month—August. About mid-October the birds and chicks drift northwards on ice floes. At about the same time the adelies come ashore for nesting, and return to the pack in February, that is, at the end of summer. There is a large emperor rookery at the junction of Ross Island and the Barrier, while adelie rookeries are spread over a wide area, their strongholds including Cape Adare, the Possession Islands, Beaufort Island, Cape Crozier and Cape Royds.

SEALS AND WHALES

Three species of seals, all members of the 'earless' group, inhabit the Ross Sea area: the crabeater, eight feet long, which feeds on crustacea; the Weddell, nine feet, which prefers fish and squid; and the Ross, also nine feet, whose chief indulgence is squid and cuttlefish. All three have been seen in the pack ice, though Weddells are usually found on the coast. They spend much of their time in inshore waters such as McMurdo Sound, lying sometimes beneath the ice and breathing through holes in the ice, and sometimes on the surface near these holes. The crabeater, essentially a seal of the pack ice, moves close inshore during the winter, but rarely comes ashore. The Ross is an extremely rare species whose breeding place is not known. A solitary elephant seal has been observed in McMurdo Sound, but the species is not found regularly in the area, and this particular individual probably arrived in an accidental drift from his normal subantarctic sphere.

Both toothed whales and baleen whales are represented in the Ross sector of the Antarctic. The former include sperm whales and beaked (bottlenose) whales, and several dolphins, the best known being the killerwhale whose role in the south is that of the shark in less frigid waters. The baleen whales are represented by rorquals (blue, fin, and sei whales) and humpback whales. The blue is the largest of all whales, measuring up to 100 feet and weighing 160 tons and more, while the fin may be up to eighty-five feet in length, the sei to sixty-five feet, and the humpback to fifty feet. All four baleen whales, and also sperm whales, have been hunted in the Ross Sea, as is indicated below.

ECONOMIC RESOURCES

The antarctic land mass has disclosed a modest reserve of mineral wealth, but with only 0.2 percent of the continent so far examined, it is impossible to foretell what may yet be found. In the Ross sector the only outstanding discovery is coal near the Beardmore Glacier where seven seams, seven feet thick, extend for 2000 miles and cover many thousands of square miles of Victoria Land. (See *Fig.* 4.) Traces of silver and gold have also been found in Victoria Land, and on the basis of comparison with other lands of similar geological structure it may be assumed that the Ross Dependency also has uranium, monazite, thorianite and manganese.[13]

TABLE I*

NUMBER AND SPECIES OF WHALES TAKEN IN THE ROSS SEA AREA IN THE PERIOD 1923-1950

Season	*Blue Whales*	*Fin Whales*	*Humpback Whales*	*Sei Whales*	*Sperm Whales*	*Total for Season*
1923-24	211	10	—	—	—	221
1924-25	408	19	—	—	—	427
1925-26	523	8	—	—	—	531
1926-27	1068	89	82	—	—	1239
1927-28	2082	110	16	—	—	2208
1928-29	1995	57	17	1	2	2072
1929-30	3043	1151	773	—	4	4971
1930-31	3734	1310	171	—	8	5223
†1931-33	—	—	—	—	—	—
1933-34	35	1	—	—	—	36
†1934-35	—	—	—	—	—	—
1935-36	156	17	4	—	—	177
†1936-38	—	—	—	—	—	—
1938-39	1010	1962	24	—	—	2996
†1939-46	—	—	—	—	—	—
1946-47	693	478	—	—	—	1171
1947-48	1636	1624	—	—	—	3260
1948-49	1043	2561	—	—	—	3604
1949-50	2631	2669	903	—	1103	7306
Totals	20,268	12,066	1990	1	1117	35,442

* The data in this table were collated by W. H. Dawbin. † No activity.

Whatever the mineral resources may prove to be, their exploitation will be a tremendous undertaking, but, following the example of developments in the Arctic, there is no justification for the suggestion that ice is itself a bar to the exploitation of these resources. If the need to exploit the minerals of the Antarctic becomes sufficiently pressing, then there is no doubt that the means will be found to satisfy the need.

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[13] Fairbridge: *op. cit.*, p. 62.

The only economic exploitation in the Ross Sea area to date has been the taking of whales, and this has been almost entirely, if not entirely, outside the three-mile limit of the territorial waters of the dependency. The New Zealand Government, on assuming responsibility for the dependency, adopted a policy of issuing licences for whaling in the Ross Sea, the fee being £200 a season, plus a royalty of 2s. 6d. for each barrel of oil procured in excess of 20,000. In adopting this policy, New Zealand was under the impression—as no doubt were some of the would-be licensees—that shore stations would be established within the dependency, as was the case in the Falkland Islands. Events were to prove that there was no need for shore stations, and when unlicensed vessels shortly entered the Ross Sea, New Zealand was powerless to enforce payment of fees and royalties in respect of operations outside the three-mile limit.

Starting with a small tally of 17,000 barrels in 1923-1924, oil production in the Ross Sea area rose to about 400,000 barrels (from both licensed and unlicensed operators) in the 1929-1930 season and again in 1930-1931, the value of the oil in each of these seasons being in the vicinity of £4,000,000. Between 1923-1924 and 1930-1931 the total known production from the area was worth about £15,000,000 of which New Zealand received £35,000 in licence fees and royalties.

So great was the oil production of the Antarctic as a whole during 1929-1931 that the market was glutted—and this at the outset of world economic recession. Needless to say, the price of oil fell and several operators withdrew. There was negligible activity in the Ross area in the 1933-1934 and 1935-1936 seasons, modest activity in 1938-1939, and none at all from then until 1946-1947. Blue whales were the favoured catch up to 1930-1931, but such were the inroads into their numbers that, as Table I indicates, attention tended to be switched in later seasons to fin whales. However, catches from the Ross Sea area have included a higher proportion of the valuable blue whales than has been obtained in recent years from any other area of the Southern Ocean, and the blue whales caught have been of a greater average size than those taken elsewhere.

DISCOVERY AND EXPLORATION

The history of the discovery and exploration of the Ross Dependency embraces a series of epics associated with such names as Ross, Shackleton, Scott, Amundsen and Byrd. Unfortunately the accomplishments of these and the many other famous explorers of the Ross territory cannot be reviewed at length here; a brief chronological outline must suffice.

Cook, Bellingshausen and the sealer John Biscoe had touched on the waters of the Ross Dependency,[14] but it was not until 1839 that land was sighted. John Balleny, an Enderby sealer-explorer, sailed from New Zealand on 7 January 1839 in the schooner *Eliza Scott,* with the cutter *Sabrina.* After visiting Campbell Island he crossed the antarctic circle in longitude 178 degrees east, veered southwest, and was almost in sight of Victoria Land when heavy pack ice forced him to the northwest, where, on 9 February, he found the islands now bearing his name. (See *Fig.* 4.)

On 26 December 1839 the United States Exploring Expedition, under Charles Wilkes, left Sydney and headed southeast, meeting the first iceberg in the northwestern corner of the waters of the Ross Dependency. There was a suggestion of land on 13 January 1840, and this was in all probability the Balleny Group, of whose discovery the Americans were not then aware.

A British exploring expedition under James Clark Ross, with the *Erebus* and *Terror,* left Hobart in November 1840 for the Auckland and Campbell Islands, and then the far south, meeting pack ice between the Balleny Islands and Scott Island. Unlike Biscoe and Balleny, who might well have anticipated him had they possessed stouter vessels, Ross had ships especially designed to meet the challenge of the pack ice. Furthermore, the ice that season enabled his sailing ships to break through in four days. Even powered vessels of the twentieth century have taken considerably longer.

After reaching the open sea which now bears his name, Ross sighted Cape Adare in Victoria Land—the first point of the mainland to be seen in the Ross Dependency. The coast veered southwards and was backed by high mountains, and there seemed nothing to stop his poleward journey until he met the ice of the coast of Ross Island. Seeking to bypass the Barrier, he sailed eastwards for a hundred miles, then turned back to search for a route west of Cape Adare, only to find the coast as continuous as ever, veering to the north and west.

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[14] The term 'waters of the Ross Dependency' here implies the sea and ocean between 160 degrees east and 150 degrees west and south of latitude sixty degrees south—that is to say, the sector embracing the islands and territories which form the Ross Dependency in terms of the Order in Council of 1923.

On 2 March he sighted the Balleny Islands and then, after sailing along the edge of the pack ice to longitude 140 degrees east, he made back to Hobart. Ross entered the pack ice again on 18 December 1841, but this time, instead of four, he took fifty-six days to reach the open

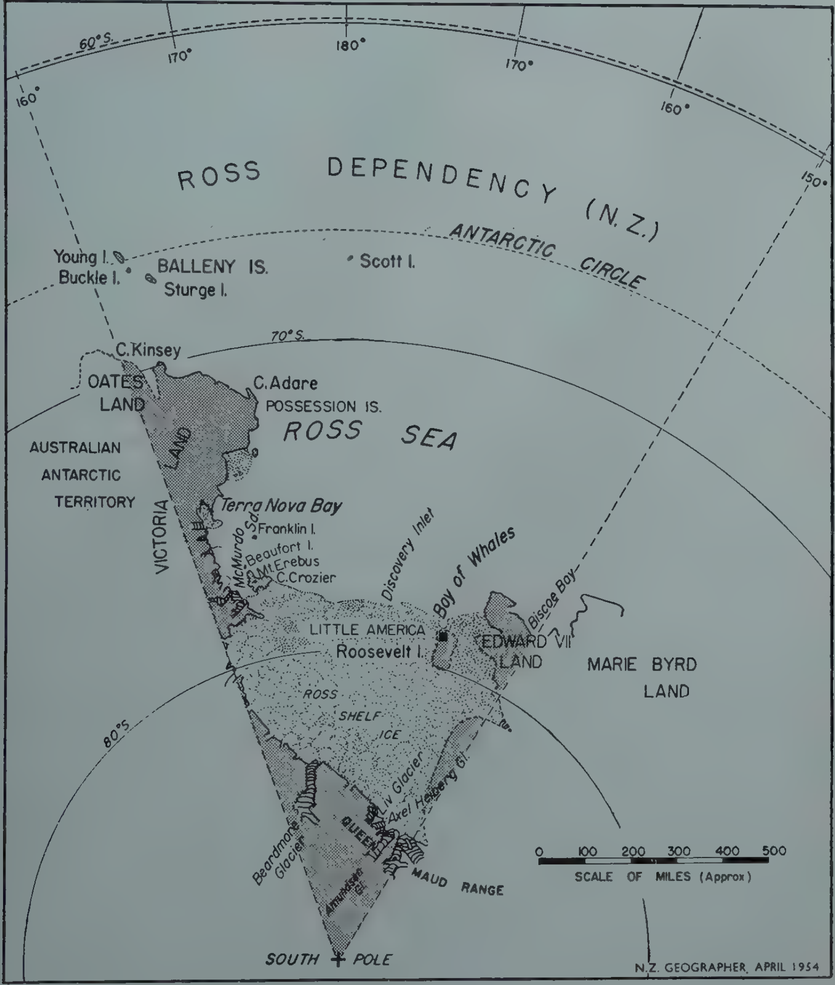

Fig. 4. The Ross Dependency.

Ross Sea. On 23 February he was at a point farthest south recorded up to that time, latitude 78° 10′, near the Bay of Whales, and he then made eastwards to 160 degrees west, meeting the pack ice which he followed eastwards, finally reaching the Falkland Islands.

For the greater part of half a century there was no further expeditionary work in the area, the only recorded visit being that of Captain

Tapsell in 1850 in the *Brisk*. He sighted the Balleny Islands and sailed westwards to longitude 143 degrees west, but saw no continental land. A Norwegian whaler, Captain Leonard Kristensen, left New Zealand on 28 November 1894 in the *Antarctic*, saw the Balleny Islands and landed on the Possession Islands; and then, on 24 January 1895, went ashore at Cape Adare, thus effecting the first landing on the Antarctic continent. An expedition commanded by C. E. Borchgrevink, who had been in the *Antarctic*, left Hobart on 19 December 1898 in the *Southern Cross*, landing a scientific party at Cape Adare to spend the winter ashore—the first time this had been done in the Antarctic—and returned for the party in January 1900. The *Southern Cross* then followed the Barrier to the Bay of Whales, where a sledging party reached 78° 50′ south.

SCOTT'S FIRST EXPEDITION

Captain R. F. Scott led the British National Antarctic Expedition, 1901-1904, leaving New Zealand in the *Discovery* on 24 December 1901. After landings had been effected at several points on Victoria Land, the *Discovery* sailed eastwards along the Barrier and made the first visit to King Edward VII Land. On 10 February the ship was back on the western flank of the Ross Dependency, at McMurdo Sound, where it was frozen in. Important sledge journeys were made, and on 30 December 1902 a new farthest south was established—82° 17′. The relief ship *Morning*, which had left New Zealand on 6 November, reached the *Discovery* on 25 January 1903, but the *Discovery* remained icebound for a second winter. In December 1903 the *Morning* and another relief ship, the *Terra Nova*, left Hobart and reached McMurdo Sound on 5 January 1904. It looked as though the *Discovery* would be icebound for yet another winter, and preparations were being made to abandon the ship when, on 16 February, the ice broke up and the vessel was freed.

Ernest Shackleton, who had been on the 1901-1904 expedition, led the next British Antarctic expedition to the Ross area, leaving Lyttelton in the *Nimrod* on 1 January 1908. He planned to establish quarters on the eastern side of the Ross Shelf Ice, but found conditions unsuitable, and so made his base at Cape Royds, Ross Island, twenty miles south of where Scott's winter party had been quartered. The first ascent of Mount Erebus was made on 10 March. On 28 October a party headed by Shackleton set out for the South Pole, discovering the Beardmore

Figs. 5 and 6. Shackleton's expedition, 1908–1909. Bay ice breaking up at Cape Royds and an emperor penguin on pack ice in the Ross Sea.

Glacier, ascending it for eighty miles, and then crossing the polar plateau to within ninety-seven miles of their objective before the precarious food situation forced a retreat. This expedition also succeeded in reaching the area of the magnetic pole. The *Nimrod* embarked Shackleton's shore party on 4 March 1909.

Naturally enough Shackleton's near-conquest of the South Pole aroused widespread interest, and it was not surprising that further attempts were shortly made to reach the pole. Two expeditions with this object were sent out: the British National Antarctic Expedition, again under R. F. Scott, whose object was primarily scientific research and secondarily the attainment of the pole; and a private Norwegian expedition under Roald Amundsen, whose sole object was to be first at the pole.

Scott left Port Chalmers in the *Terra Nova* on 29 November 1910, and made his winter base at Cape Evans, on the western side of the Barrier. Amundsen, who had left Norway in the *Fram* on 9 August 1910, set up quarters in the Bay of Whales on the eastern side of the Barrier. Amundsen's polar party left base on 19 October, making its way to the plateau by way of the Axel Heiberg glacier, while Scott's party left base on 1 November and proceeded by way of the Beardmore Glacier. Amundsen, with dog teams, reached the South Pole on 14 December 1911; Scott, using ponies for a start and then manhandling the sledges, reached the goal on 17 January 1912. Amundsen enjoyed a relatively easy run back to the Bay of Whales, embarking on the *Fram* on 30 January, but no such good fortune attended Scott and his four companions, all of whom perished on the return from the pole to Cape Evans.

Yet a third expedition was in the Ross Dependency in 1911-1912. Lieutenant Choku Shirase, commanding the Japanese South Polar Expedition in the *Kainan Maru,* left Wellington on 11 February 1911, rounded Cape Adare, passed the Possession Islands, met thick pack ice on 12 March, and finally retired to Sydney. Leaving Sydney on 19 November, the *Kainan Maru* again made for Cape Adare, thence to the Bay of Whales where a shore party remained while the ship went on to Biscoe Bay. Heavy ice forced the ship to retreat to the Bay of Whales, and on 4 February 1912 the shore party was picked up for the return to Wellington.

Shackleton's Expedition: 1914-1917

The next expedition to the Ross Dependency again centred around Ernest Shackleton. He planned to sledge across the Antarctic continent from the Weddell Sea to the Ross Sea, and it was necessary that food depots should be laid inland from the Ross Sea for his use in the concluding stages of the journey. The depot-laying party left Hobart in December 1914 on the *Aurora,* with Captain A. Mackintosh in charge. Ten men were landed at Cape Evans, and then the *Aurora,* beset in ice, drifted away, leaving the ten men to spend the winter as best they could in Scott's old encampment. They were precariously short of food and equipment, but after a hazardous winter they set out to lay the depots, not knowing that Shackleton's *Endurance,* like the *Aurora,* had been caught in the ice on the other side of the continent, and that an end had been put to the transcontinental crossing. In most difficult circumstances the Ross Sea party laid depots for 370 miles from Cape Evans. Nor was there any relief when summer came, and they spent yet another winter ashore, before being relieved by the *Aurora* in February 1917. Three of the ten men lost their lives during their arduous stay ashore.

The 13,000-ton factory ship, *Sir James Clark Ross,* under C. A. Larsen, with five chasers in company, visited the Ross Sea for the 1923-1924 whaling season, this being the first season following New Zealand's assumption of responsibility for the dependency. Larsen used Discovery Inlet as a base, entered McMurdo Sound, and followed the coast of

Victoria Land to Cape Adare. In the next season Larsen again visited the Ross Sea. The Bay of Whales, which had been ice-bound in 1923-1924, was now open, and a chaser steamed to the edge of the Barrier at the head of the bay. Factory ships and attendant chasers continued to visit the Ross Sea each season until 1930–1931, and thereafter spasmodically.

AMERICAN EXPEDITIONS

Rear Admiral R. E. Byrd, of the United States, left Dunedin in the *City of New York* and the *Eleanor Bolling* on 2 December 1928, carrying aircraft in which he intended to fly to the South Pole. At the edge of the pack ice the factory ship *C. A. Larsen* met the *City of New York* and towed her to the open water of the Ross Sea. The two American ships joined company at the Bay of Whales where a base known as Little America was established. The *City of New York* made two unsuccessful attempts to reach Biscoe Bay, and on 22 February she left the Bay of Whales to winter in the north, meeting such heavy pack ice that she had again to seek aid from the *C. A. Larsen*. Byrd's shore party made flights into Marie Byrd Land, and a sledging group reached the Queen Maud Range. On 28 November 1929 Byrd and four companions flew over the Liv Glacier to the South Pole, returning by way of the Axel Heiberg Glacier.

Admiral Byrd commanded another expedition, in the *Jacob Ruppert* and the *Bear of Oakland,* in the 1933–1935 seasons, again using the Bay of Whales as base. On 14 February 1933 the British Discovery Committee's vessel *Discovery II,* answering a call from Byrd for the dispatch of a doctor to the far south, left Dunedin and met the *Bear of Oakland* at the northern edge of the pack ice where the doctor was transferred to the American ship. After wintering at Little America, Byrd's shore party carried out sledge journeys and aircraft flights in the following spring and summer, and on 6 February the *Bear of Oakland* and the *Jacob Ruppert* evacuated the party.

On 23 November 1935 Lincoln Ellsworth and a companion set off by air from Dundee Island (off Graham Land) along the Weddell coast and then headed across to the Ross Sea. After a hazardous flight they reached the vicinity of the Bay of Whales and took shelter in one of Byrd's huts. Meanwhile the supporting vessel, the *Wyatt Earp,* finding all radio communication with the plane disrupted, and fearing the worst, attempted to reach Charcot Island. She was foiled by heavy pack

Figs. 7 and 8. Shackleton at Cape Royds. Mt. Erebus and stores buried in frozen spray after a blizzard.

ice, and so continued westward to the Bay of Whales, where she arrived on 19 January 1936, only to find that the *Discovery II* had anticipated her by four days and had rescued Ellsworth and his copilot. The *Discovery II* had been heading southwards and eastwards from the Crozet Islands when she was diverted to Melbourne to pick up men and provisions to aid in the search for Ellsworth.

On 22 January 1936 the *Discovery II* moved westwards along the Barrier to Cape Crozier, reaching there on 25 January. The ship then headed northwards, charted the Balleny Islands, and returned to Melbourne. Departing from Fremantle on 29 December 1937, the ship visited the Balleny Islands in January 1938 and, after making a two-day running survey, sailed north to Dunedin. In February 1938 the vessel went south again, meeting the pack ice in longitude 170 degrees west, and proceeded on a zigzag course to the Bellingshausen Sea.

Admiral Byrd made yet another visit to the Ross Dependency in 1939-1941, as leader of the United States Antarctic Service Expedition, with the *North Star* and the *Bear*. The *North Star* reached the Bay of Whales from Dunedin on 11 January 1941 and the *Bear* from Balboa on 15 January. Flights were made to the Queen Maud Range and along a considerable portion of the Pacific coast. The two ships revisited the dependency in January 1941, evacuated the shore party from the Bay of Whales, and moved towards Scott Island and then eastwards along the northern edge of the pack ice before proceeding to the United States in May.

The Americans made a summer cruise to the Antarctic in the 1946–1947 season. Again Byrd led the expedition. This time there were thirteen vessels and 4000 men, the largest expedition ever to visit the Antarctic. The main purpose was to provide naval training, to carry out research, and to test equipment under low-temperature conditions. Included in the expedition was a submarine which was found unsuitable for the conditions, and, after being towed north, it spent some time in Wellington. The expedition worked around the continent in three groups. The central group, based on Little America, made an extensive photographic study of the Ross Barrier and the coasts of King Edward VII Land and Victoria Land, and on 15 February 1947 Byrd made his second flight from Little America to the South Pole. Several of the expedition ships, in addition to the submarine, visited New Zealand on the way back to the United States.

New Zealand and the Dependency

The foregoing notes may provide some hint of the significance of the Ross sector in the record of Antarctic exploration, and the prominent part that New Zealand has played as a supply base and port of call in enabling expeditions to use the Ross embayment to best advantage. But it will be noticed also that there is no mention of any expeditionary work having been initiated by New Zealand itself, either before or since the assumption of responsibility by the dominion in 1923.

On 15 November 1923 Captain G. S. Hooper of the Marine Department was appointed 'Officer of the Government of the Ross Dependency', with general executive and administrative authority and also 'all the powers and authorities which may be exercised in New Zealand' by a stipendiary magistrate and by a justice of the peace.[15] Armed with such authority, Captain Hooper visited the Ross Sea in the 1923–1924 season aboard the first Norwegian factory ship operating under New Zealand licence. Captain Hooper's successor as Officer of the Dependency, Captain W. Whiteford, accompanied a similar cruise in the 1926–1927 season, and Captain W. W. Stuart, the third to hold the post, in 1929–1930.[16]

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[15] *New Zealand Gazette,* Vol. III, 1923, p. 2815.

[16] Captain Stuart continued to hold the appointment until his death in August 1952. In September 1953 Captain H. Ruegg, Nautical Adviser to the Marine Department, was appointed his successor.

The three visits by these officers afforded no opportunity of a landing on the dependency to perform any overt act in demonstration of sovereignty, although the terms of their appointment were clearly designed to that end. Nor has any other official representative of the Government of New Zealand set foot on the dependency in the thirty years New Zealand has controlled the territory.

International Questions

From time to time circumstances have focused attention on New Zealand's relationship with the dependency, as, for example, when the Americans established a United States post office in the Bay of Whales during the 1928-1930 expedition. Then in 1929 doubt was cast on the validity of the 1923 order in council.[17] There arose the suggestion—which was not acted upon—that the order be revoked and replaced by a clarifying proclamation. Another suggestion, designed even further to remove any doubts as to New Zealand rights in the dependency, was to extend the southern boundaries of New Zealand to include the dependency. This, also, was not acted upon, and there still remains a gap of seven degrees of latitude between the southern limit of New Zealand and the northern limit of the dependency.

A further wave of interest in relationships between New Zealand and the Ross Dependency arose through a combination of circumstances in the years immediately after the Second World War. These circumstances were: the crisis over claims to territory in the American sector which caused comparisons to be drawn with New Zealand's claim to the Ross division of the Pacific sector; the dispatch of an official United States expedition to the Ross area; and the granting of permission by the Allied control authorities for the recommencement of Japanese whaling in the Antarctic. On this occasion the oft-raised proposal that New Zealand's documentary rights should be backed by expeditionary reality received official approval, but no progress was made beyond preliminary committee investigations.

Suggestions have also been made from time to time that New Zealand should participate in whaling in the Ross Sea. The cost of establishing a modern whaling expedition would, however, most likely be beyond New Zealand's resources, even if there were reasonable assurances of good annual catches and a good market for each year's oil. The recruiting of staff would be in itself a major difficulty, for New Zealand would probably find, as have most other countries, that it would need to engage a large proportion of Norwegians to man the factory and the chasers. Furthermore, New Zealand's proximity to the Ross Sea is not necessarily a good argument in favour of a New Zealand whaling expedition—it would be just as economical for an experienced expedition to come from the northern hemisphere, take the oil from the Ross Sea, and return with it to northern hemisphere markets as it would be for New Zealand to take the oil from 1500 miles south of the dominion, process it, and convey it to world markets in the northern hemisphere. Furthermore, now that there is an international agreement stipulating a maximum aggregate catch of baleen whales each season, the entry of a new operator means a reduction in the quantity of oil which each can take, for the same grand total must then be spread among a greater number of operators. An inexperienced New Zealand fleet could hardly hope to secure a catch comparable with that of more skilled whalers by the time the aggregate was reached and a halt thus called to a season's activities. The economics of the whaling industry seem weighted against direct New Zealand exploitation of the Ross Sea in the face of competition from established and experienced foreign operators.

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[17] A. H. Charteris: 'Australasian Claims in Antarctica', *Journ. Comp. Legis. & Internat. Law*, Vol. XI (Third series), November 1929.

STRATEGIC IMPLICATIONS

Nevertheless New Zealand's proximity to the antarctic regions compels an alert watchfulness over developments affecting those regions, for it is of primary importance in any pattern of New Zealand or South Pacific defence that the safety of the southern approaches be ensured. It does not seem unreasonable, therefore, to suggest that New Zealand defence personnel should receive some practical experience in conditions pertaining to the far south, and this would seem to apply specially to the dominion's naval defence forces.

It is unnecessary in the present age to make out a case for a nation building up a corps of scientific research personnel with special reference to that nation's particular environment. New Zealand's environment is such that the study of subantarctic and antarctic problems must be a constant concern of this dominion. Already New Zealand scientists have made significant contributions in the subantarctic sphere, but unusual opportunities are afforded on an even broader scale in the antarctic territory.

As has been mentioned above, any conclusions regarding the mineral wealth of the Antarctic are based on an examination of only a small proportion of the continent. It would be surprising if a continent of five million square miles did not eventually yield resources of importance to world economy, but an answer to that problem depends upon further research and exploration. Because of the relatively easy access which it permits to the polar hinterland, the Ross Sea area assumes a role of greatest importance in the carrying out of such research and exploration. This is the area of the Antarctic for which New Zealand is responsible, and this responsibility must carry with it an obligation to pursue scientific inquiry. Such inquiry would provide unique scope for dominion scientists in circumstances which, perhaps more than any other, would be conducive to initiative and enterprise and to the strengthening of morale among research workers in New Zealand.

The Challenge of the South

No thought of exploiting the economic resources of the Himalayas lay behind the conquest of Mount Everest; yet no single event of recent times has done more to enhance the morale of the British Commonwealth of Nations than this victory over the hazards and mysteries of Nature. The difficulties and rigours to be faced in the Ross Dependency, and the mysteries to be resolved, are similarly a deep challenge to human effort and human ingenuity. The meeting of such a challenge has an ennobling influence, beyond economic measurement, on the spirit of a nation, and investments in ventures designed to meet a challenge of this kind are therefore investments in the pulse and fibre of a nation's life.

The time appears to have come when New Zealand should reexamine its attitude toward the Ross Dependency and the southern regions as a whole. This reexamination should be entrusted to a panel capable of framing a constructive course of action for the immediate, and also the more distinct, future. This panel should not only look upon the dependency from the viewpoints of defence, economic potential, and opportunity for scientific research, but should also recognise the equally important factor of the enrichment that will come to the nation's life when its people go out to meet the challenge of the Great Far South.

THE THAMES DISTRICT*

BRYAN H. FARRELL

THE NAME 'Thames District' serves to designate an area approximately eighty square miles in extent which lies to the southeast of Auckland in the North Island of New Zealand. It is adjacent to the southern extremity of the Hauraki Gulf and is roughly triangular in shape. It extends from the coastal settlement at Waiomo in the north to a southern baseline which runs through Ngatea and Wharepoa. About midway between the base and the apex, dominating the area in many ways, and providing a focus of both attention and activity, is Thames, the largest town and only centre of significant size (*Fig.* 1).

The Thames District includes strongly contrasted elements of both surface form and human use. It is characterised by well-marked areal diversity. The fundamental contrast is that between desolate rugged uplands and prosperous well-used plains. Today man justifiably ascribes more importance to the lowland dairy farms than to the massive volcanic dykes and struggling forest of the upland. But this has not always been the case. Within the area, especially in the uplands, features still exist which faithfully record the exploitative economy of the past. On the plains are features which attest to the manner in which acquired technical skill has in recent times overcome substantial physical obstacles in the conversion of large areas of swamp into well-ordered farmland.

In the Thames District much that is characteristic of the geography of New Zealand is mirrored in miniature: cut-over forest, reverted pastures, exotic grasses, intensive dairying, scrubland, small rural townships, upland and plain. All are found in close association.

THE PHYSICAL SETTING

The area is one of 'mountains' and plain and these two major physical divisions are not separated by any large area of transition (*Fig.* 1).

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* The object of this paper is to draw attention to characteristics of outstanding geographic significance within the area and to describe and interpret briefly the major patterns and particular combinations of features that exist together. A comprehensive coverage of the geography of the area is not within the scope of this paper, nor is it intended that the study should be primarily one of 'town and region'. Grateful acknowledgement is here made to the third-year students of the Department of Geography, Auckland University College, who mapped the land use.

The rugged Cape Colville Range in the east with its ragged crestline stands in sharp contrast to the featureless plain below. The actual height of the range is no more than 2500 feet, but abrupt change of slope from upland to plain makes the well-dissected hill country appear mountainous.

As a result of vulcanism, igneous, andesitic and dacitic rock are dominant in the lithology of the upland.[1] In addition, hydrothermal activity associated with the vulcanism endowed the area with minerals which later became of the greatest economic importance towards the end of last century. Faulting and crustal deformation, together with subsequent denudation in a mild moist climate, help to account for the irregular and rugged nature of the hill country.

Hill Country and Plain

North of the town of Thames the uplands nose their way to a boulder-strewn coastline. Within the upland region a few pockets of flat land are found, notably along the coast at Puru and Tararu and on the bottom lands of the Kauaeranga Valley. In the particular area under survey uplands account for almost half of the total land area. West of the hill country and south of Thames lies the lowland, a small portion of the larger Hauraki Plain.[2] Flat and featureless, it slopes very gradually from sea level on the mudflats of the Firth of Thames to approximately fifteen feet above sea level in the vicinity of Paeroa, sixteen miles from the sea. Beneath this unbroken surface lie vast accumulations of sand, clay and gravel, the result of centuries of sedimentation by the ancient Waikato River and later by the drainage systems of the Waihou and Piako Rivers. Today these two perpetually cloudy streams, their courses confined between solid earth-built stop-banks, meander northwards towards the mangrove-fringed sea—a direct contrast to the rushing mountain torrents in the valleys of the ranges to the east.

The climate of the area is both humid and mild. Summer temperatures are warm and winter frosts are infrequent. Over most of the lowland yearly precipitation amounts to between forty and fifty inches

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[1] For a detailed account of the geology and physiography of the Coromandel Peninsula see C. Fraser: 'The Geology of the Thames Subdivision', *N.Z. Geological Survey Bulletin No. 10*, Wellington, 1910; and J. Henderson: 'The Geology of the Aroha Subdivision', *N.Z. Geological Survey Bulletin No. 16*, Wellington, 1913.

[2] The Hauraki Plain or Thames Valley and the Coromandel Peninsula have already been described. See Murray McCaskill: 'Coromandel Peninsula and Thames Valley', *N.Z. Geographer,* Vol. 5, No. 1, April 1949, pp. 47-71; and *idem: Coromandel Peninsula and Thames Valley,* Unpublished thesis presented for the M.A. degree in the University of New Zealand, 1947.

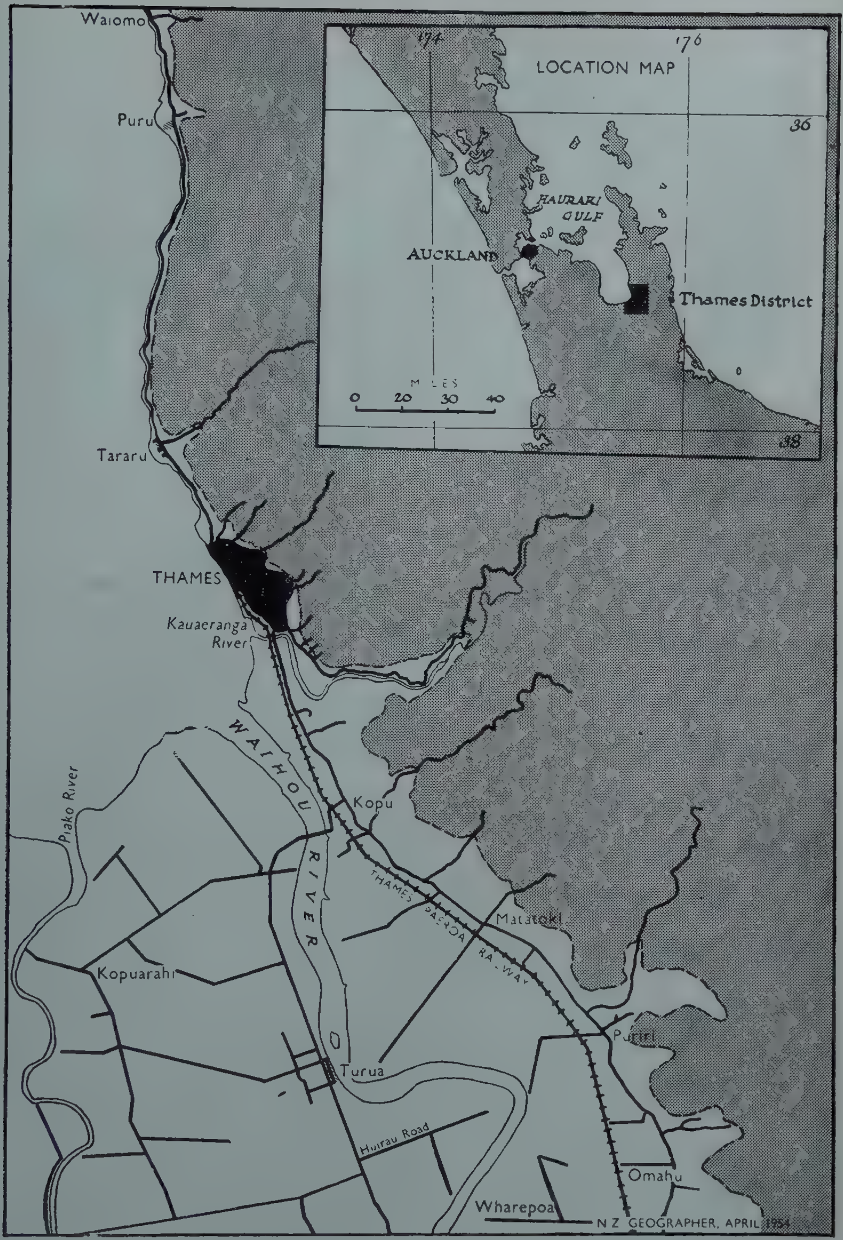

Fig. 1. The Thames District: Its location and major features. The upland area is stippled; the lowland area has local relief of less than 200 feet and a prevailing slope of 0–10 percent.

a year. Only in the uplands, which benefit from both frontal and orographically-induced rainfall, are high totals of seventy and eighty inches reached. Throughout the year both temperature and effective rainfall are sufficient for the growth of plants almost all the year round.

Drought conditions are unusual. These were the genial climatic conditions under which former forests flourished and under which present-day grassland farming prospers.

On the arrival of the first settlers much of the lowland area was in swamp. Associations of raupo, flax and manuka scrub were found on the lowest parts whilst majestic clumps of kahikatea swamp forest clothed slightly better drained areas. On the hills grew subtropical rainforest—a forest with kauri-tawa the dominant association. Along the coast and elsewhere scrub and fern were prevalent.

Since the end of the eighteenth century this plant cover has been vastly altered. Sawmiller, gumdigger, miner, engineer and pastoralist have determinedly transformed the indigenous vegetation, sometimes for the better, often for the worse.

Historical Background

A detailed survey of chronological development is unnecessary here. However, the history of the area is so spectacular and of such import that, in order better to appreciate the present landscape, reference must be made to processes and events which through the course of little more than a century have contributed to an amazing transformation.

The early Maori inhabitants lived in close harmony with the land, and cultivation practised on the lower hills or peripheral swamplands disturbed the habitat but little. This simple and sympathetic relationship of man with his land—enforced by the Maori's lack of technical skill—was to be shattered by the arrival of European ships at the end of the eighteenth century. Soon swampland and neighbouring valley rang with the blows of the foreigner's axe, and barques loaded with white pine (kahikatea) left the mouth of the Waihou to initiate the first economic link with the outside world. The 'Thames story' had started. The early and sporadic trade in timber gave way to more regular shipments to the United Kingdom for the British navy and mercantile marine, to Australia and even to China.

The forest-clad ranges—in places but a stone's throw from the present town—were clothed with stands of giant kauri. In the hands of ruthless woodsmen, kauri soon became most remunerative. Masses of jostling logs were flumed down steep-sided mountain valleys by the release of impounded water. Timber moved in this manner towards the sea, and later towards both sea and town. Today as a result of both fire and axe, darkened and charred remnants rise from scrub, fern and second growth. Occasionally enclaves of native trees are found amidst association of indigenous-induced species. Insignificant remnants, the vestige of once-flourishing forest, still remain on both hill and plain. *Raubwirtschaft* has extorted a heavy toll. Settlement took on an air of permanence only after 1867. Before that only a mission station had been established. This was at Puriri, south of the present town.[3] Although forest exploitation was in progress the timber-winners' settlement was of a transient nature.

Discovery of Gold

In 1867 gold was discovered on Maori land. With little time lost, and after considerable scheming, negotiations for the land were completed with the Maori landowners. On 30 July 1867 a small area near the present town was declared a goldfield. The following day inaugurated one of the fastest and most spectacular population growths in the history of New Zealand. From nothing in 1867 the population soared to an estimated 20,000 three years later.[4] The first settlement took place at Shortland, now the southern end of the present town. It was not very long before the main surge of immigration was felt. Miners from other parts of the country, from California and from the goldfields of Ballarat and Bendigo poured into town. Not only miners arrived. Tradesmen, speculators, labourers and professional men were emptied into waiting tenders and landed at Shortland.

Although Shortland served as the initial centre and was well placed in relation to the harbour facilities of the time, miners and other workers had to walk a mile or more to the hills in the north where the mines were situated. It was obvious that little time would elapse before a centre was established in the north, and subsequently a new settlement took shape at the foot of the hills close to the scene of mining. Located here were batteries to process ore, mine pumps, hotels, hundreds of rapidly-erected wooden dwellings roofed with kauri shingles, and great numbers of canvas tents. Two centres thus developed: Shortland in the south and Grahamstown in the north. Between the two were scattered buildings and a long boggy track. Industrial activity developed in the north. Foundries were established to repair and maintain mining equipment and wharves were built on the adjacent waterfront. A railway was even built north to a deep-water berth at Tararu.

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[3] G. N. Scoble: *History of the Hauraki Goldfield,* Unpublished thesis presented for the M.A. degree in the University of New Zealand, 1951, p. 5.

[4] J. Grainger: *The Amazing Thames,* Wellington, 1951, p. 14. Estimates of population vary. McCaskill (*op. cit.*) gives the figure as 12,000. The census for the year 1871, the peak year of gold production, gives the combined total of the two towns as 5792 and the figure for the Thames electorate as 11,950. Ten years later the population of Thames had fallen to 4863—a figure slightly above that for 1951 when the total was 4551.

The hillsides were burnt and cleared to give ready access to the mines, and little narrow gauge railways ran from nearby valleys to converge on the batteries of Shortland Flat. Such a period of hectic and energetic exploitation of minerals and timber left a landscape marked with the scars of irresponsible activity. Topsoil slid from burnt-off hills into the valleys below, and forest gave way to scrub. Many of the wounds of yesterday have healed, but the land to a large extent remains desolate. Behind the town routeways, formerly well worn, now penetrate blindly into valley culs-de-sac, overgrown walking tracks still lead to the old workings. Hills are gorse-covered and dangerously pock-marked with tunnels and subsidences. The scene is, in many ways, depressing.

TABLE I

PRODUCTION OF GOLD AND SILVER IN THAMES COUNTY 1867–1908*

Year	*Value*	*Year*	*Value*	*Year*	*Value*
1867	£20,700	1883	£150,914	1899	£70,364
1871	£1,188,708	1887	£98,860	1903	£55,128
1875	£259,709	1891	£116,624	1907	£181,169
1879	£165,183	1895	£63,913	1911	nil

* Source: Fraser: *op. cit.,* p. 10.

During the heydey of the Thames goldfields about seventy mines were working between the Tararu and Hape Creeks especially in areas drained by the Kuranui, Moanatairari and Waiotahi Streams. For the first ten years of bonanza mining about £4,000,000[5] (at the contemporary price) of gold and silver were produced, and by the time mining was almost finished at the end of 1908[6] the area had yielded £7,075,131 of precious metals (Table I).

After 1871 mineral production and population both declined. By 1910 population had fallen to a little over 3500. Many of the original buildings had been destroyed by fire or demolished. The two settlements had grown together along an attenuated stalk, Pollen Street.

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[5] Grainger: *op. cit.,* p. 15.

[6] The last mine closed in 1910.

Fig. 2. Patches of grassland, scrub and secondary forest in the upper Kauaeranga Valley.

Photo: R. Hargreaves

The building of locomotives, the manufacture of sawmill machinery, and general engineering replaced the mine-oriented manufacturing of the preceding forty years. Certain industries were forced to leave Thames, whilst others collapsed during the years of decline. But 1910 was a momentous year in another way. Mining had died but the drainage and development scheme on the Hauraki Plain was under way, and the first farms had been allocated by ballot.

Work preparatory to drainage had commenced in 1902.[7] Between 1907 and 1910, when settlement first took place, great strides were made with swampland reclamation. Stopbanks were built along the main rivers and the seashore to prevent flooding. In addition, ditches and canals were dug at right angles to the rivers to remove surplus water from the land. Raised roads were formed from spoil dug from ditches, and road gravel was brought from nearby hills. Work proceeded steadily. Eventually nearly all the lowland within the region was brought into profitable use.

The drainage project, although opposed in many quarters, brought vitality and a firm economic base to the declining town of Thames through the opening-up of what was to become some of the best land in the country. The emphasis had now moved from hill to plain, from the temporary resources of timber and metal to the more substantial resources of a carefully-husbanded soil.

The last forty years have been years of adjustment for Thames. The growing prosperity of the town, the result of the development of nearby farmland, encouraged rebuilding and general civic improvements which led to the assumption of a financial burden the town was later unable to carry. Thames gained a fillip in 1926 with the commencement of the Waihou Bridge which, when completed, gave direct access to a large portion of the Hauraki Plain. But in 1927 the New Zealand Government Railways changed its policy and the town no longer received orders for locomotives. Unemployment followed. Finally a national depression aggravated the unfortunate economic conditions already existing. Thames came through the economic crisis not unscathed. The last twenty years have shown some improvement but few marked changes. The town has remained relatively static for a long time.

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[7] R. R. Gillespie: *The Development of the Hauraki Plains*. Unpublished thesis presented for the M.A. degree in the University of New Zealand, 1948, p. 21.

PRESENT-DAY LANDSCAPE

Human occupance of the area has produced a complex landscape exhibiting few similarities with the relatively simple, undisturbed terrain of a century ago. Natural vegetation, for example, is no longer the single most dominant feature. The entire aspect of the land has changed under the impress of man and his works.

Today all but the rougher uplands are used; much of the land is intensively used. No flat land remains to be reclaimed. The lowlands now carry herds of dairy cows on high-quality pastures of English grasses and are closely divided into small highly-productive farms. Near the meeting place of plain and upland lies a small area of transition made up of rolling country, reverting pastures and carrying a more varied livestock association. Close by, directly to the east, rise 'worn-out' hills. A full understanding of the character of the rural portion of the Thames District must embrace then, among other things, an interpretative study of livestock farming and a comparative study of hill and plain. Together these provide a key to the geography of the district.

The plain, once under swampland associations and now drained, is almost entirely under permanent pastures of ryegrass and white clover, with some paspalum. These rich exotic pastures are supported by poorly-drained heavy clay meadow soils whose inherent fertility has obviated the use of expensive fertilisers. Farther east the arrangement of vegetation and soils is different (*Fig*. 3). On this flat-to-rolling better-drained country—and essentially the same may be said for the small coastal pockets north of Thames—patterns become less homogeneous and more complex, broken and varied. First-class permanent pasture gives way to poorer types. Grasslands are infested with scrub and fern. Still farther into the uplands occasional pockets of pasture are found among the undesirable vegetation. On steeper slopes poorer grasses such as danthonia and browntop are associated with large areas of scrub and fern. Eastward of the scrub the vegetative cover changes abruptly to forest. In most cases this is secondary forest which is

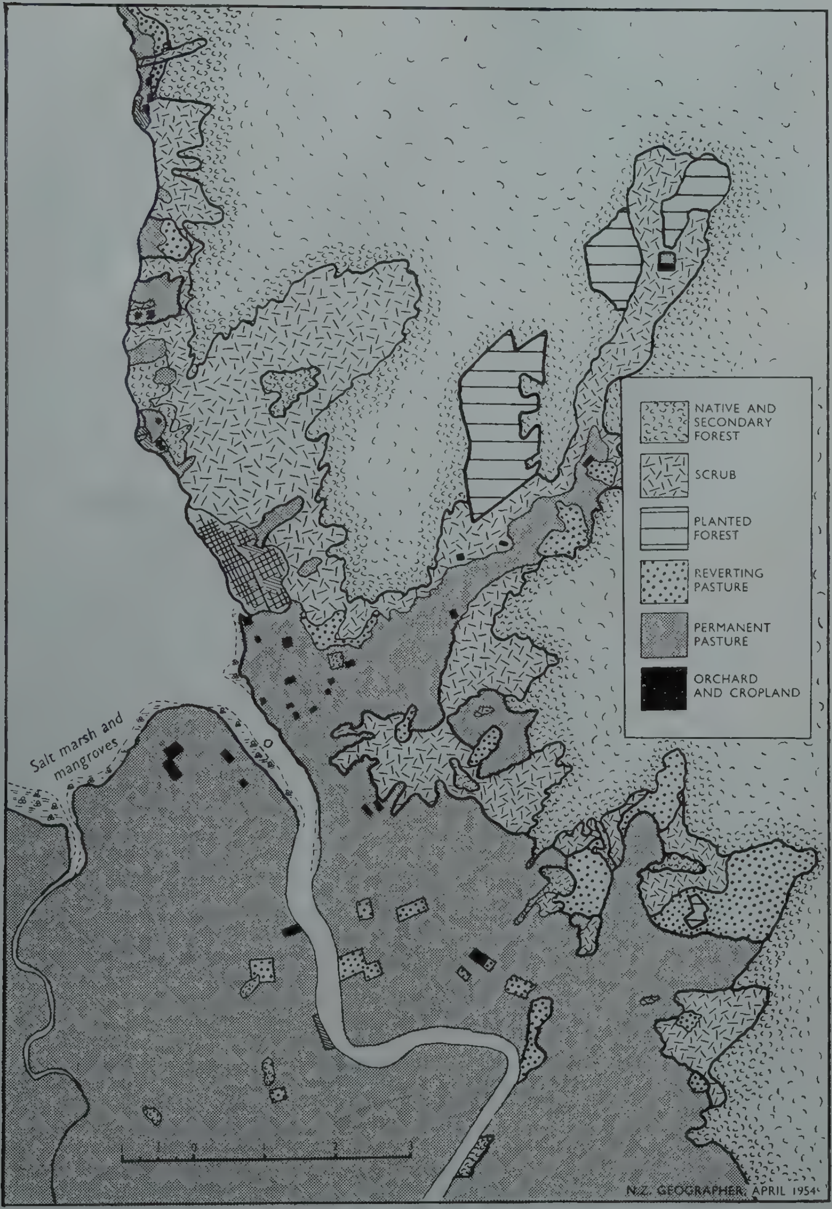

Fig. 3. Rural land use in the Thames District, May 1952.

regenerating after fire or the effects of timber-felling and which covers much of the uplands. In several places tongues of forest or scrub encroach upon established pasture land.

The soils supporting this transitional grass-scrub-forest cover are also varied in both character and distribution. For the most part they are brown granular clays developed from volcanic parent material and early ash showers. Like the lithosols in the higher forested area they are much lower in fertility than the meadow soils of the artificially-drained lowlands. The clays are greatly improved for farming purposes by the application of lime or fertiliser, both of which stimulate the growth of good-quality pasture.

Land use in the Kauaeranga Valley is represented mainly by a complex of irregularly-shaped fragments of diverse character. Only a large-scale map could do justice to its variety. Contemporary vegetation includes not only exotic pine forest, scrub and pastures of varying quality, but also patches of arable land, vineyards and orchards in the lower valley. Other orchards are found on coastal flats at Puru and Tararu. In the Kauaeranga Valley and on the coastal flats soils are alluvial in character, and, like the volcanic soils, can be improved markedly by artificial means.

PREDOMINANCE OF DAIRY FARMING

Dairying is the predominating type of farming throughout the area as a whole, but the size of individual farms varies considerably. On the plain, where no livestock other than dairy cows are seen, farms average 90 to 100 acres in size. Approaching the uplands the average farm size increases to as much as three times that of farms on the lowlands between the two rivers. In addition the emphasis on dairying diminishes. Inhospitable circumstances of slope and soils have made farming difficult in the upland areas. Timber milling, once so important, is now of little consequence.

On the lowland, individual fields average about five acres in size and are usually rectangular in shape. Almost without exception their surfaces are cut at regular ten-chain intervals by shallow open ditches. Run-off from rainfalls of characteristically high intensities is conducted from these surface drains towards deeper communal drains, and thence through automatic flood gates to the Waihou or Piako Rivers. Land immediately to the east of the Waihou River is artificially drained as well, but nearer the upland the removal of surplus water is not a

Fig. 4. Maintenance of drainage ditches on the Hauraki Plain.

Photo: B. Nicholls

problem. In this transitional area individual fields are larger and have a disorderly pattern conforming very much to irregularities of surface. Over much of the Thames District the land is very often divided by shelterbelts of barberry, pampas grass (on the plain), variegated privet, or coniferous trees. The provision of shelter not only serves a useful need in farming practice but also tends to emphasise the regional distinctiveness of the lowland.

The buildings of individual farms are bunched together close to a road, and comprise at least the house, a cowshed, a garage and an implement shed. Many farms have a building for storing hay, and most lowland dairy farms run a small tramline between the milking shed and the road for the easy conveyance of milk cans, especially during the wetter months with their associated muddy conditions. A double-fenced stock race enclosing a narrow concrete walk extends the entire length of most farms to facilitate the handling of dairy herds and for the conservation of pasture. The concrete walk prevents this central routeway from becoming a muddy quagmire in winter and spring, and for the same purpose crushed stone is spread about all well-used gateways.

The ensemble of farm buildings and the 'look' of the farm appears very much the same throughout the area. There are, of course, some variations. Between the plains proper and the uplands the assemblage of buildings occasionally appears a little less compact. The cowshed is smaller and placed farther from the house—in some cases it is even absent—and because of better drainage towards the east the central concrete walk tends to disappear and artificial forms of drainage are no longer obvious.

Throughout the area livestock farming is dominant. Lowland farms specialise in dairying. On these lowland farms herds of Jersey or Jersey-cross cows produce milk which is processed in nearby dairy factories, five of which lie within the Thames District. On the artificially-drained plain sheep are uncommon, but their numbers increase nearer the hills, and a few farms on the steeper, more rolling country, carry no other livestock.

In this eastern area the type of animal run on particular farms is dictated not wholly by the character of the land but just as much by the personal fancy and financial position of the farmer. The tendency is for individual farms to concentrate on one type of animal, so that although within this smaller area livestock are mixed, this is not usually the case on individual holdings. Dairy farming is still important, but sheep farms and run-off farms are both represented, and on the higher, poorer areas farmers concentrate on store sheep or cattle.

Local Farming Problems

Within the entire district almost no cash or feed crops are grown. To provide supplementary feed the usual practice is to shut off a small area of the farm. The pasture saved can later be used for making hay or silage. Most pastures are rotationally grazed and some farmers have further refined this practice by the use of electric fences to control stock feeding on the high-producing lush pastures of the plain. In general the techniques of farming are highly efficient. Farming is highly mechanised, and the use of milking machines is universal. All farms are supplied with electric power. Labour for permanent or casual work is scarce and most work is done by the farmer and his family. With a low application of labour to the land the output per man, under almost ideal conditions for grassland farming, is particularly high.

In spite of advantages they find in the area, farmers must meet certain local problems. On the plain drainage canals and stopbanks must ever be maintained. Channels must be rid of deposited silt and choking mannagrass. During the damp winter the resistance of livestock is lowered, with the result that farmers must continually be on the lookout for various diseases. Poaching also is a major problem of the lower country. Some mention has already been made of the necessary central concrete pathway. During wet months, because of inadequate drainage, areas well frequented by livestock become deeply pock-marked with hoof prints. In early summer this broken ground dries hard and cracks, and opens the pasture to infestation by such noxious weeds as buttercup and pennyroyal. In many cases the resulting decline in production in such areas is very marked but hormone sprays have largely solved this weed problem. On some previous occasions the cracked earth has provided a breeding place for millions of grass-devouring crickets. A solution for these most costly invasions seems to be met by rolling and compacting the surface before it dries in summer.

Fifty percent of the farmers on the plain send about two-thirds of their cattle to 'run-offs' in the nearby hills when pastures on the plain are most susceptible to poaching. This migration takes place in late autumn and early winter. The cattle return to the home farm later in the year for calving. By this method the home farm is kept in good condition and production rises, but the crucial problem of poor drainage on the lowland is no nearer solution. Farm administration also is difficult and expensive since run-off farms are from three to twenty miles away.

The farmland away from the plain and approaching the upland forests has its own peculiar problems. Here the carrying capacity of the land is lower than on the plain. Small areas of good pasture on valley bottoms and on easy country are used for dairy farming, but on the steeper slopes soils are thin and poor and the percentage of scrub and weed infestation is high. Major problems of this more easterly area include encroaching scrub and maintenance of fertility. Scrub and fern are combated by the use of cattle and giant discs, but in some parts fire is still used. Dressing with phosphatic fertilisers and lime helps to raise productivity and so provide a surer protection against scrub infestation. Aerial topdressing is becoming increasingly important and may succeed, where most other methods have failed, in pushing good farming land farther into the agriculturally-unproductive hill country.

Patterns of Settlement and Communication

The Thames District is by no means a heavily-populated area. Settlement is closer on the plain than in any other part of the area, and essentially it assumes a well-spaced linear pattern following closely the arrangement of roads. Buildings are closer together along the main roads and are farther apart on less important routes. Near the hills settlement is dispersed and of lower density. There is little settlement of significance outside the lowlands. In any consideration of the overall settlement pattern one is inevitably impressed by the concentration of settlement at Thames and by the extent of the area over which the town spreads compared with other urban centres within the area. Because of its dominance and its unifying influence within the area, Thames, along with its northern 'satellites', is given separate attention below.

Little urban development has taken place on the plain probably because Thames was established at an early date. As the lower Hauraki Plain was reclaimed, and later with the opening of the Waihou Bridge, Thames was in a position to assume responsibility for all but the immediate local needs of the lowland dweller. Most villages are situated at road junctions, but only in the case of Puriri and Matatoki is nucleated form at all apparent. These two centres, along with Kopu, all on the east margin of the plain, are aligned along the main Thames-Paeroa highway parallel with, and close to, the railway. Turua is the only centre of any note occupying a position well within the limits of the plain.

FUNCTIONS OF TOWNSHIPS

In general, rural townships are small and are concerned with serving immediate local needs. The processing of liquid milk is very often an important additional function, although a dairy factory is not always located in a rural centre. Factories are sited at Kopuarahi, Matatoki, Wharepoa, Turua and Huirau Road.[8] In all cases they are situated in a position to serve the needs of local dairy farmers. For business transactions of an important nature, for professional services, for the purchase of items other than daily requirements, and for many social and recreational needs the country people look to Thames. There many retailers are able to offer a wide selection of goods, and many of a different nature from those stocked by smaller centres. The attraction Thames exerts in the field of commerce deserves special recognition. The commercial dominance of the town is an essential aspect in the geography of the Thames District.

Within the area are two distinctive patterns of communications: the hill pattern and the pattern on the plain. On the plain the arrangement of straight roads follows no obvious plan or order. The two

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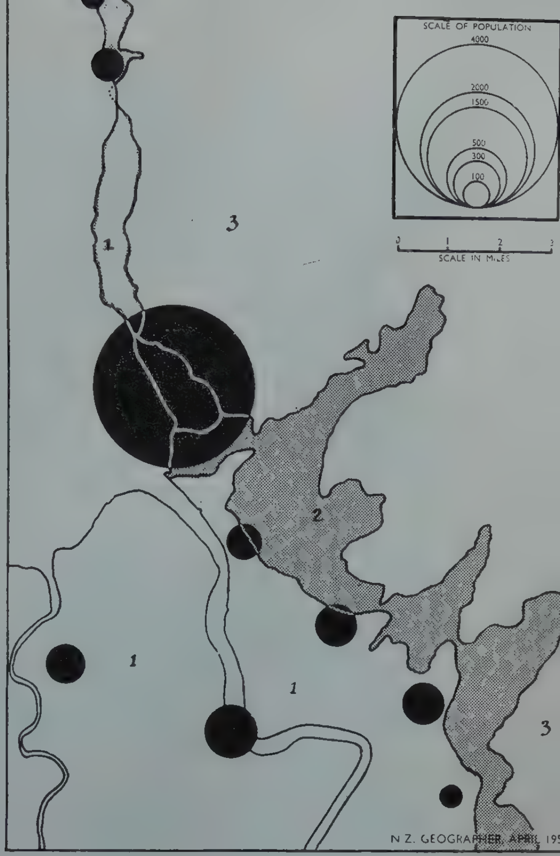
[8] These are all cheese factories, but at the time of the survey, May 1952, the first three factories were temporarily producing casein.

Fig. 5. Population by localities; and regional subdivisions:

1 Dairying area of the plain,

2 Transition area, 3 Hill country.

The transition area is stippled. North of Thames the coastal pockets of dairying have affinities with the plain, but also mark the transition to the more extensive farm economies further to the north.



main roads trend approximately north and south, and in the north they merge into the one route to Thames. In the south these roads proceed to Paeroa. Between the main roads and the two rivers are numerous short feeder roads which end at the river stopbanks. On the eastern margin of the plain, to the east of the Waihou River, is the Thames-Paeroa highway and the railway. North of Thames a road skirts the shore and follows the coastline through Waiomo to Coromandel.

East of the railway and the Thames-Paeroa highway the road pattern changes abruptly, and becomes less dense. This is the 'hill pattern'. Roads are no longer on flat country. They twist and turn with the contour of the land. These routes are aligned northeast-southwest, and on no occasion do they continue for more than seven or eight miles inland. Without exception they are short dead-end roads serving only scattered hill-country farms.

All north-south traffic passes through Thames. In addition, the town lies alongside the well-roaded area at the northern extremity of the plain. Within the entire district there is virtually no east-west through traffic. All through traffic must travel approximately in a north-south direction, and this, in the end, must be advantageous to Thames.

Areas of Marked Individuality

The geography of the Thames District clearly indicates the distinctive individuality of three separate rural areas. These are the plains dairy area, an intermediate transition area, and the hill country (*Fig.* 5). The dairy area occupies the lowland approximately between the Piako River and the railway. The transition area includes all the farmland to the east of the plain together with flat deltaic outliers to the north of Thames. The hill country designates the unproductive area to the east of the transition area and much of the inland area to the north of the town.

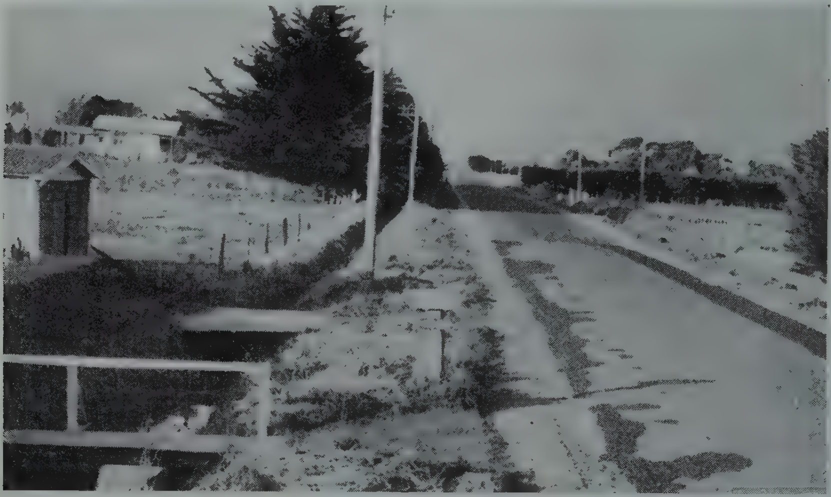


Photo: B. Nicholls

Fig. 6. The plain: straight roads, ditches, shelterbelts and hedges, and houses close to the road.

Most of the plain was formerly covered by swamp. Today this remarkably flat area is stamped with straight lines—drainage ditches, fences, hedgerows, windbreaks, country roads, and the railway on the eastern border. In general, patterns are rectangular in irregularly spaced groupings. Pastures are rich and carry fine herds of cows. Colour is outstanding. The rich greens of the fields, the waving silver plumes of pampas-grass shelter, the more sombre macrocarpa hedge, and the dun-coloured rivers together provide a variegation of colour in bold contrast to the more uniform shades of darker green and brown of the hills to the east. Dashes of bright colour are given by the painted iron roofs of farm houses well spaced along the rural roads but rarely set back far from the road frontage. Along the roads, especially off the main routes, motor vehicles provide fast links between farm and factory, or town and country—more specifically between the plain and Thames.

The transition area possesses traits which are in part those of the upland and in part those of the plain, yet the character of the area is such that it must be considered distinctive. The area, which averages two miles wide, stretches from the south northwestwards to Thames. North of the town the two noncontiguous flats at Tararu and Puru may be considered outliers of this area. The only inland extension of any importance lies along the Kauaeranga Valley. This is an area of rolling hills, broad valleys and occasional river and coastal flats, supporting some good grass, scrub and struggling reverting pasture. Because of the absence of artificial drainage the imprint of man is not so marked as on the plain. Man is less obvious in other ways. Settlement is more dispersed, there are fewer concentrations of habitations, and few roads. In many ways the countryside lacks the air of movement which is characteristic of the dairy area. The landscape is essentially heterogeneous rather than homogeneous. This region is one of variety—of landforms, soils, vegetation associations, livestock and agricultural methods, all found in close areal association.

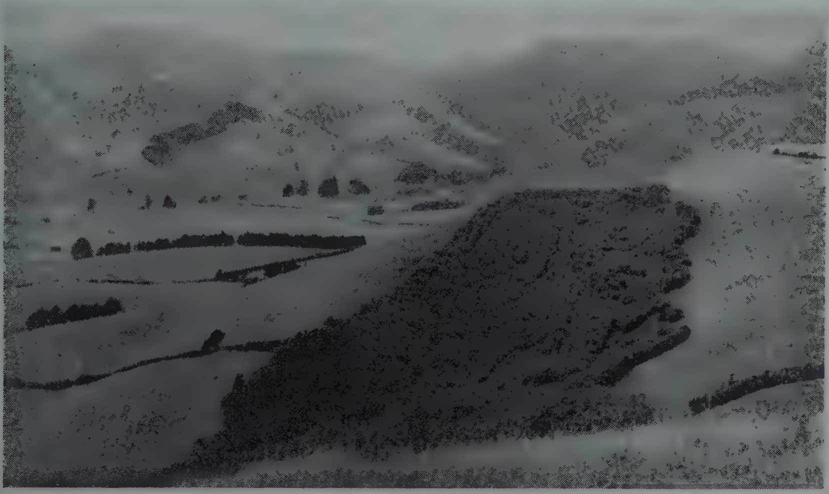


Photo: R. Hargreaves

Fig. 7. The hill country: valley pastures, patches of scrub, and broken bush-covered hills.

The hill country lying to the east of the transition area is a complex of ridge and valley, rocky faces and steep slopes, scrub and second-growth forest. Characteristic of the upland is its lack of human occupance, its atmosphere of inhospitality and its appearance of unproductiveness.

Although these three areas appear distinctive they by no means function as discrete units. In aggregate they constitute the Thames District, a functioning area which derives considerable unity, if not uniformity, from the centralising influence of Thames.

THE TOWN

Thames is at the northernmost corner of the Hauraki Plain. The town nestles between the sea and the nearby hills and nowhere is the settled area more than three-quarters of a mile wide. Its site is generally flat and lowlying and because of this many small areas have been reclaimed or considerably improved by the use of mullock and other waste materials from mining. The hills that confine the town in the east also provide a similar barrier again in the north where hill and sea come together. Still farther north only a narrow fringing strip and two small coastal alluvial fans are suitable for settlement.

Figure 9 indicates in a general manner the town's contemporary morphology and land use.[9] Residential land extends roughly from the Kauaeranga River in the south to Puru and beyond in the north. Between the main part of the town and Puru, along the fringing strip, are several noncontiguous aggregations of settlement each characterised by *Strassendorf* form. Essentially much of this is discontinuous dormitory suburbs.[10]

In the central portion of the town settlement is very different. Houses are close together and little vacant land is to be seen. North and south of the central area the scene changes. Settlement becomes increasingly more dispersed and irregular in pattern towards the extremities of the town. The widest part of the town is an extension of the central portion of the main body eastwards on to low hills. North of this two lines of houses extend into the hills along narrow valley bottoms. Throughout the town most residences are of one storey and made of wood. Occasionally a few multi-unit buildings are found in the

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[9] Although additional categories of urban land use were employed in the actual survey the categories used in the cartographic presentation are considered the maximum number that can be satisfactorily portrayed at the scale used.

[10] This northern extension of the borough is too elongated in shape to be shown conveniently on Figure 9.

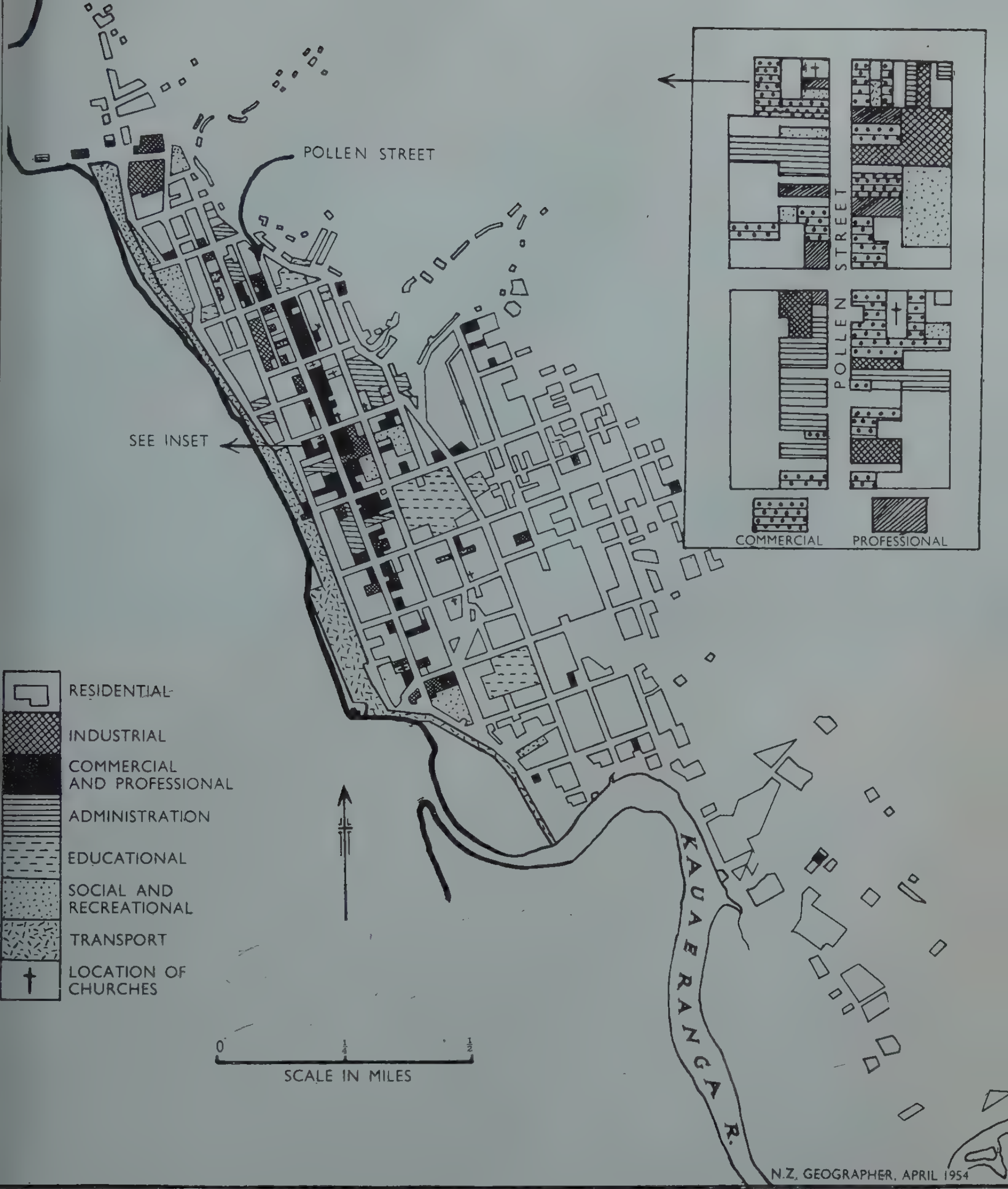

Fig. 8 Thames: urban land use, May 1952 (scale of inset map three times that of the major map).

older parts of the town where houses are cramped together on small plots of ground.

Thames has a very high percentage of its working population engaged in industry. The presence of heavy industry and of steel-making facilities in such a small town with no basic raw materials at hand is most unusual for New Zealand. The two large foundries located in the northern part of the town were formerly associated with mining. Today they are concerned mainly with repair and overhaul of such equipment as locomotives, logging and sawmilling machinery, and earth-moving equipment. In addition to this heavier type of industry, which bears little direct relationship to the surrounding countryside, a variety of manufacturing is found in the town. Timber milling, fish processing, textiles, joinery, implement repair and maintenance, and printing are all represented. The only real concentration of industry is found in the northwest part of the town between the main street, Pollen Street, and the waterfront. The rest is unevenly distributed in the town near, but not actually on, the main street. Although nearly all industrial raw materials are imported and many products find markets in other parts of the country, Thames at least has the advantage of an adequate and stable labour pool. There are few other locational advantages.

TABLE II

WORKERS ENGAGED IN INDUSTRY, 1952

	*Workers Engaged in Secondary Industry**	*Workers Engaged in Engineering and Metal-working Industries**
Thames	50	24
Hamilton	32	9
Auckland	48	12
New Zealand	38	10

* Expressed as a percentage of the total of *all* workers. Data from published figures of the Department of Census and Statistics and from an unpublished survey of the Department of Labour.

The town caters adequately for its present educational, recreational and social needs. Approximately a dozen churches, four schools and a school of mines are within the borough limits. Land used for school buildings is evenly distributed within the town. In terms of area alone, land used for educational purposes is most significant. A large area in the central portion of the borough is used for the buildings and playing fields of the high school.

Most goods and passengers are carried by road, and these services, together with private motor transport, play an important part in knitting together town and country and in connecting Thames with other urban centres. The railway is less important, although the yards constitute a long and narrow transport area to the west bordering the sea and extending almost the entire length of the town. Inward rail freight

Photo: R. Hargreaves

Fig. 9. Thames: the more recent fringes and the delapidated centre.

clearly predominates over outward.[11] Other than general goods, inward freight comprises coal, heavy articles and machinery for repair, and industrial raw materials. Outward freight is made up of timber, repaired machinery and fish.

Land used for commercial and professional purposes dominates the main street. Shops and stores are found on the eastern side of the street while premises occupied by the post office, banks, law firms, doctors and other professions occupy much of the other side. The commercial area could never be designated a core. It extends through the central part of the town, mainly on one side of the main street, for at least three-quarters of the street's length. The town has an abundance of retailers; far more than most New Zealand centres of 4500 people.[12] This is because Thames services a large rural area outside the town itself. Although specific services extend well outside the area studied, the Thames District may be considered as the core of the town's service area. Most merchandise comes from Auckland wholesalers and approximately half is distributed within the town.

Thames is well equipped for its size. It is able to offer retail, professional, financial, hospital, educational and social facilities not only to urban dwellers but also to much of the Coromandel Peninsula and to a large part of the lower Thames Valley.

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[11] 'Railways Statement', *Append. Journ. House of Repres.* (D-2), Wellington, 1952, p. 27. (*Outward freight:* Timber 126,600 superficial feet; Other goods 2449 tons. *Inward freight:* Timber 91,400 superficial feet; Other goods 11,975 tons; Cattle 643; Sheep and pigs 6136.)

[12] The *Thames Star,* Monday, 19 May 1952, p. 5.

CONCLUSION

Within the Thames District are four easily distinguishable areas. Each is distinctive and possesses its own particular character. Three areas are rural and one is urban. Together these constitute the Thames District, an area which is given its essential unity by Thames. This major urban centre, through its services to, and close relationship with, the surrounding country, has welded several dissimilar regions into a coherent whole. On the other hand, the town's genesis, continuing existence and present state of wellbeing are all to some extent reflections of the varying influences exerted by the countryside on the town for almost a century. In addition, however, it must be remembered that much of the town's industrial activity has little relationship with the immediate rural area.

The plain is representative of the best dairy land in New Zealand. Problems associated with farming in the Thames District are by no means insurmountable and not all problems are in the sphere of agricultural science. Given sufficient economic incentive, and using improved techniques, farmers of the area could add considerably to the national income. An immediate increase in production of at least forty percent is certainly not outside the area's capability. In addition any increase in the productive capacity of this portion of the Hauraki Plain is likely to find urban expression in the renewed development of Thames, a town that has remained relatively static for a considerable period.

The Thames District has had a chequered history which is to a large extent mirrored in the present-day landscape. The uplands in their present state of decadence reflect the disharmony produced at an early date by wholesale exploitation of irreplaceable natural resources. Today this area is little used by man. On the other hand, the lowland reflects man's ingenuity in overcoming physical barriers. Technical skill, careful husbandry and inherent fertility have made a former swamp the productive heart and core of the Thames District. Throughout this period of changing ideas, values and skills, Thames has continuously played its part in providing services to its country hinterland.

A PHYSIOGRAPHICAL STUDY OF RECENT SAND DUNES ON THE AUCKLAND WEST COAST

R. N. BROTHERS

ON THE western coast of Auckland, between Kaipara South Head and Anawhata, there are long belts of wind-blown sand which reach inland as much as four miles and cover an area of about eighty square miles (*Fig.* 1). These sands, commonly known as the west coast black sands, are of Recent age and their dunes cover coastal forelands for over thirty-five miles along this shore. The large foreland north of Muriwai provides the best examples of sand belts and dune forms.

A long curved beach stretches from Muriwai for twenty-eight miles northwest to Kaipara South Head and terminates in a large sandy hook. The beach is wide and steep and is backed by a high foredune behind which a series of sand waves extend inland. The older beds covered by the dunes on South Kaipara Peninsula are poorly-compacted Pleistocene sandstones; these end abruptly on the western side in cliffs traceable from Kaipara South Head to Muriwai along a line about two miles inland from the Tasman Sea.

Three series of Recent sand dunes are present on this section of the coast, and these are here named Group I, Group II and Group III, the last being the youngest. The three series may be seen in the aerial mosaic of Figure 2. The oldest dunes (Group I), in a belt averaging a mile in width, have advanced far inland over the much-dissected Pleistocene sandstones, and occupy deep gullies as elongated ridges parallel to the present prevailing southwest wind. The dunes have been built up to 500 feet above sea level and are similar in form to other landward portions of dune areas in the North Island described by Cotton.[1]

The dunes of Group II were built west of the base of the cliffs carved in the Pleistocene sandstones and rarely exceed 200 feet in height. The series is a quarter of a mile in width and has the form of anchored foredunes which in many places are superposed on the longitudinal dune ridges of Group I. The dunes of Group II, with high slopes

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[1] C. A. Cotton: *Climatic Accidents in Landscape-making,* Christchurch, 1942, p. 109.

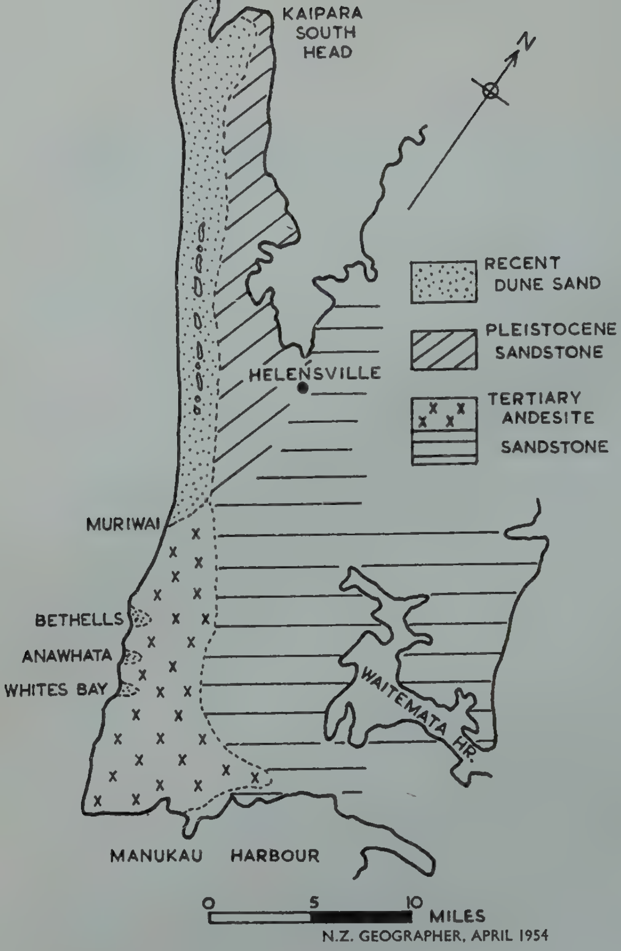

Fig. 1.
Geological sketch map of the Auckland west coast from the Manukau Harbour to Kaipara South Head.

on both windward and leeward faces, form roughly parallel ridges with a northwest-southeast trend and contain a line of elongated lakes in the interdune hollows (*Fig.* 2).

Group III is the most recent and lies furthest to windward and nearest to the sea. It consists of a thick sheet of loose sand in lobate ridges which rise up to 250 feet above sea level and have steep sandfall slopes to the east and northeast. The dunes have advanced over those of Group II, and at the present time are gradually encroaching on many of the lakes mentioned above. Although the average width of this belt is one and a quarter miles, to the north it reaches five miles, where, in the Kaipara South Head area, the sands completely cover the dunes of Group II and Group I and have advanced over the surface of the basement Pleistocene sandstone.

A diagrammatic representation of the three groups given in Figure 3 may be compared with the photograph of Figure 2. The three series may be further distinguished in aerial photographs by the different types of vegetation on each. Group I, the oldest, has a loamy soil supporting a fairly dense cover of shrubs and other plants, particularly manuka (*Leptospermum scoparium*), toetoe (*Arundo conspicua*), *Cassinia retorta,* bracken fern and exotic grasses, but Groups II and III have scant coverings, hardy grasses being found on the former, and on the latter only those native plants adapted to loose sand habitats (for example, *Desmoschoenus* and *Spinifex*).

The forms of all the dunes indicate development under prevailing southwest wind conditions. Local observations[2] show that this wind averages from fourteen to sixteen miles per hour up to 500 feet above sea level, with occasional velocities reaching from sixteen to twenty miles per hour.

PHYSIOGRAPHIC DETAILS OF DUNES IN GROUP I

The oldest dunes are best developed between Kuwakatai Lake and the end of Bests Road, southwest of Helensville. North of the lake they are buried by dunes of Group III and south of Bests Road extensive afforestation with pines has masked the initial form of the dunes.

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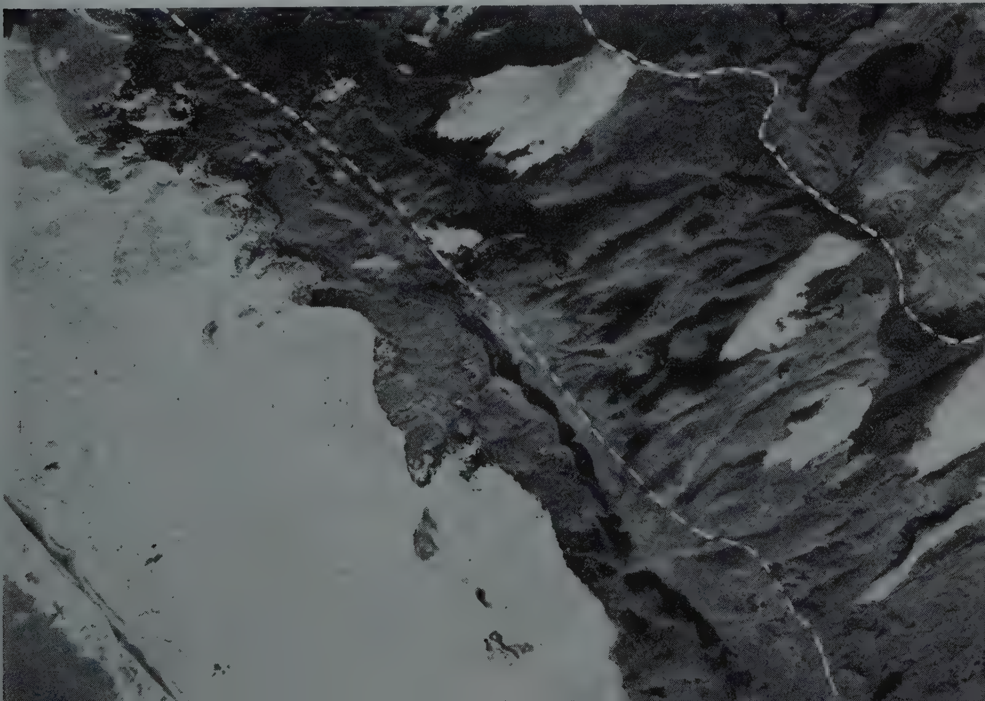
[2] See L. N. Larsen: 'Visibility and Upper Winds at Auckland, Wellington and Christchurch', *Meteorological Office Note, No. 20,* Wellington, 1938.

Fig. 2. An area six square miles in extent and twenty-one miles north of Muriwai. From east to west, the Pleistocene basement, Group I and Group II, with large blowout dunes in the Group I area.
Photo: Department of Lands and Survey



Although this group is the oldest of the three generations of sand dunes, it is heavily clothed with grasses and shrubs, and the dunes have maintained their early outlines. The group contains a number of dune types, and a division may be made into 'primary forms' which were originally developed in loose free-moving sand, and 'secondary forms' which are a later result of wind in conflict with the vegetation. A broad present-day differentiation between the two is that the former are fixed dunes, whilst the latter in the main are active. Most of the dune types have been named elsewhere.[3]

The primary forms of Group I have been determined by the nature of the surface over which the sand advanced—in this case a much-dissected but fairly steep cliff face carved earlier by waves on the western side of the Pleistocene sandstone peninsula. This face was extensively gullied, and against the resulting gashes the first upward movement of Recent sand took place, giving rise to three main types of dunes.

Dune Forms

Wind-shadow lee dunes, or *tail dunes* were developed behind sandstone erosional residuals at the top edge of the cliffs and were continued to the northeast as long tapering ridges parallel with the wind direction. A similar origin has been suggested by Cotton for many of the longitudinal dunes in the landward portions of coastal dune areas in the North Island. The dunes are characterised by their parallelism and sharp crests, the heights of which, being dependent on the sizes of the protecting rock masses, range from a few feet to sixty feet. Unlike typical longitudinal dunes, however, they often do not show a symmetrical cross section, one side being banked up against a spur of the protecting promontory. The length of these tail dunes varies, but individual examples have been seen up to 500 yards long at the end of Evans Road, four miles due west of Parakai.

Funnelled dunes entered the gullies which cross the steep cliff slope and were probably responsible in the first instance for the development of the tail dunes higher up above the gullies. Melton believed that where a dune enters a gully the sand is swept upwards and beyond to form new dunes, but the examples seen on the upland fit more closely an illustration given by Bagnold where sand entering a wind gap is severely 'funnelled'. In the present case the force of the wind has been concentrated by having to enter a bottleneck at the gully mouth; air currents bouncing off the rock floor have swept upwards to splay out the sand into a U-form like a drawn-out hairpin with the prongs opening out into the wind. The narrow windward ends of the dune are plastered well up on the gully walls, but the dune has grown in width and height as the air currents have become more diffused to leeward of the gully mouth. The dimensions of the air channel in a funnelled dune three-quarters of a mile west of Evans Road are 400 feet from crest to crest across the ends of the prongs and 230 feet from trough to crest. The latter distance diminishes rapidly to leeward.

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[3] See F. A. Melton: 'A Tentative Classification of Sand Dunes—Its Application to Dune History in the Southern High Plains'. *Journ. Geol.,* Vol. 48, 1940, pp. 113-174; R. A. Bagnold: *The Physics of Blown Sand and Desert Dunes,* London, 1941; and T. O. Bosworth: *Geology and Palaeontology of North-west Peru,* New York, 1922.

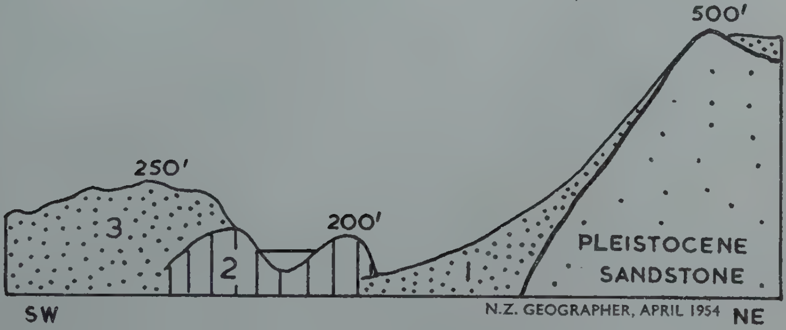

Fig. 3. A diagrammatic representation of the three dune groups.

The funnelled dunes and the longitudinal tail dunes together form parallel ridges that traverse the upland behind the cliffs.

Undercliff dunes[4] are present as massive sand drifts built against the face of the cliffs and fashioned into two different forms. Where the cliff is more or less vertical an undercliff dune has formed in front of an eddy hollow or air cushion at the cliff base. In contrast, where a gentler slope existed, a sheet of sand has gradually crept upwards to release a series of longitudinal dunes at the top of the cliff. Below the cliffs the primary dunes of Group I are continued seawards as a mixture of lobate and longitudinal dunes which disappear, at about twenty to fifty feet above sea level, beneath the anchored foredunes of Group II.

The secondary dunes of Group I have been quickly developed from the loose sand of the primary dunes where burning-off has taken place, or where animal tracks are numerous, or where a protective cover of vegetation is lacking because of inadequate plant colonisation. The wind has eroded a shallow basin and piled the sand to leeward in the form of a crescent, the wings of which open towards the wind. This is the blowout or parabolic dune of Melton and earlier writers, and on the South Kaipara Peninsula it is developed mainly in the hollows between the various longitudinal dune ridges already described as primary forms. As the wind has been guided in channels along these depressions the situation has been ideal for rejuvenation of sand movement to yield secondarily-formed blowout dunes. Many of the blowout dunes have migrated downwind as long, hairpin-shaped dunes (the elongate-blowout dunes of Melton), progressively burying and killing the vegetation of the depressions as they advanced. By coalescing on the leeward side of the main Pleistocene bedrock divide they have formed a number of large sand drifts which now menace fertile farmlands on the east coast of the peninsula. It was probably one of these drifts that was recorded west of Woodhill by Cockayne as having an average advance of nine feet a year over a period of forty-four years prior to 1910.

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[4] L. Cockayne: 'Dune Areas of New Zealand'. *Append. Journ. House of Repres.* (C-13), Wellington, 1911.

Individual blowout dunes attain large sizes, as is shown in Figure 4 where the sandfall slope is sixty feet high, and elongate-blowout dunes may reach half a mile or more in length. There is evidence that many blowout dunes existed early in the history of Group I, for in a few localities some have been fixed by successful plant colonisation—as, for example, west of the end of Evans Road where a complex of all dune types is located.

Physiographic Details of Group II

The dunes which fall within Group II are situated to the west of those of Group I and about half a mile west of the cliffs carved in the Pleistocene bedrock. They form three, or at most four, parallel ridges trending roughly northwest-southeast and not truly at right angles to the prevailing southwesterly winds, although short tongues have been developed on the eastern side coinciding in direction with these winds. The sand slopes are fixed by grasses and occasional small shrubs, but the plant cover is not as well established as that of Group I. The crests of the dunes are rounded rather than sharp and rarely reach more than 200 feet above sea level. This sand belt now extends from about four miles north of Muriwai to a point half a mile south

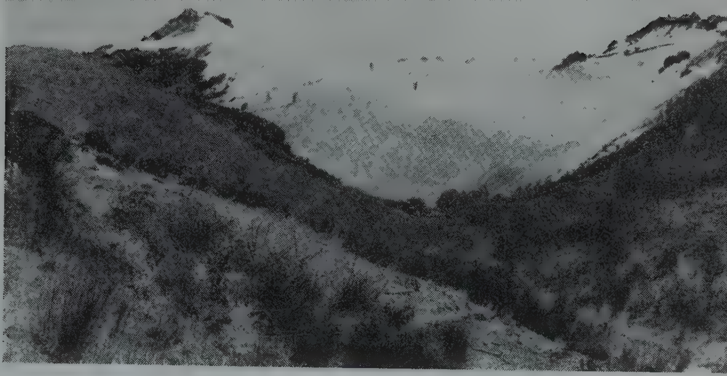

Fig. 4. Sandfall slope of a blowout dune, sixty feet high, advancing along the troug between primary longitudinal dunes.

of Kuwakatai Lake; it once existed north of this point where, like Group I, it is buried by the younger dunes of Group III that have travelled inland.

In the hollows between the major dune lines there are oval, often lake-filled, depressions enclosed by short cross-arms of sand which join up the main dune ridges. These arms are spill-over buttresses built in the lee of foredunes rather than irregular arcuate parts of the leeward side of transverse dunes. The dune forms are identical with Melton's source-bordering lee dunes—the foredunes of other writers—of which he writes '. . . they may originate as an interlocked chain of elongated petal-shaped plates of sand with a spoonlike depression in the middle of each . . . these dune ridges may grow to great size because of the relatively constant position of the source of sand, constant wind direction, etc.'[5] The fixed dune ridges of Group II are parallel to the present Group III foredune of Muriwai Beach which is not parallel to its own wandering transverse dunes for, by lying at right angles to the prevailing southwesterly wind, the latter make an angle of about twelve degrees with the shoreline. As no evidence has been found elsewhere to indicate any lengthy periods of change in effective wind direction, it follows that the lines of dunes forming Group II must have made an angle with the wind and could not have been located anywhere other than at the back of a beach—that is, in the position of foredunes.

PHYSIOGRAPHIC DETAILS OF GROUP III

This is the youngest of the three series and has an average width of two miles. It originated behind the beach that runs for twenty-eight miles approximately northwest from Muriwai. The shoreline is an asymmetrically concave line which at first is more or less straight for twenty miles and then bulges seawards, later to be recurved to the east in the sandy hook at Kaipara South Head. This cuspate shape is the result of contrasting processes even now affecting the shoreline: retrogradation along the straight portion and progradation at the bulge.

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[5] Melton: *op. cit.*, p. 123.

The 'straight shoreline' trends thirty degrees west of north and is therefore not at right angles to a wind blowing from the southwest. As a result, transverse dunes behind the beach lie at an angle of ten to fourteen degrees with the shoreline, and the sand moves along the coast to a small degree as well as inland. A foredune backing the steep wide beach is continuous from Muriwai township along the entire length of the shoreline, rarely being more than thirty feet high and seventy feet wide, and is broken only by the mouth of Okiritoto Stream. Many large blowouts have been developed by the removal of loose sand from the seaward face of the foredune, producing large marram grass hummocks with short tail dunes. Thus the seaward side of the foredune is built up of short lobate spurs which at the present time are being sporadically cut back by waves to form steep walls as high as ten feet. These erosional features are not so well developed on the foredune of the 'bulged shoreline'. Immediately to leeward of the foredune and parallel to the beach is a well-defined shallow eddy hollow, downwind from which the loose sand rises again as long tongues gaining height inland. These tongues unite to form parabolic transverse dunes made up of small arcuate portions as Cotton suggests.[6] Though not particularly steep, the sandfall slopes of the transverse dunes are, however, pronounced at the eastern edge of Group III where it is covering Group II and has advanced into many of the lake basins.

An Area of Progradation

The 'bulged shoreline' extends along the cuspate northern ten miles of Muriwai Beach, the only part of the west coast of the present area to exhibit active progradation over the last seventy years. Comparison of the map of Waitemata County of 1880 with the corresponding sheets of the 1 : 63,360 series of 1943 shows that in sixty-three years progradation of more than half a mile has taken place at the bulge. The longshore current from south to north along this coast would normally deposit a large amount of sand here where it meets the strong inflowing and outflowing tidal currents at the entrance to the Kaipara Harbour. This process has been accentuated by the erosion of foredunes taking place on the straight shoreline immediately north of Muriwai and further south at Whites Bay, Bethells Beach and Anawhata. A good supply of sand has thus been provided for progradation of the bulge and for dune formation in the northern area. In particular near Kaipara South Head this is shown where the dunes of Group III have ascended the line of cliffs, covered Groups II and I, and advanced over the Pleistocene bedrock to within one mile of the east coast of the peninsula. To the west of the line of cliffs irregular transverse dunes characterise Group III, but where the dunes rise rapidly to the cliffs steeply sloping drifts, almost identical in form with correspondingly situated dunes of Group I, mark the movement of the sand to higher levels. East of the cliffs transverse dunes and irregular drifts have re-formed and at a height of 300 feet above sea level have an average thickness of from fifty to sixty feet, though at their eastern limit the thickness is about 150 feet.

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[6] Cotton: *op. cit.*, p. 106.

FORMATION OF KAIPARA SOUTH HEAD

The formation of the large Kaipara South Head hook and the enclosure of Waionui Inlet were concurrent with the development of the Group III sand belt. Deflection of the south-north coastal current by prevailing southwesterly winds and inflowing tidal currents caused the building of a large shoal which was located west of Kaipara South Head and north of the growing dune belt of Group III. The seaward edge of the shoal curved north-eastwards into the mouth of the Kaipara Harbour and an embankment was gradually built above sea level to enclose partially a sheet of water now represented by Waionui Inlet. Currents entering the Kaipara Harbour have drawn out the embankment as a long narrow spit or hook, one and a half miles long and with a general width at low tide of 120 yards, though as much as 250 yards at its distal end. The northeast trend of this hook accentuates the curve of the seaward edge of the embankment. Refraction of waves sweeping in from the open sea by the zone of shallow water has played a dominant role in moulding the form of the hook, for at the latter's strongly recurved distal end the wave lines are finally turned through 180 degrees. Stages in the growth of the hook are shown by two curved projections on its landward side half a mile and three-quarters of a mile from its free end (*Fig.* 5).

The surface of the embankment enclosing Waionui Inlet now bears low-lying transverse dunes up to 100 feet high, separated in many cases by wide saline swamps. These dunes have advanced no further to leeward than the base of the hook, although sand carried on by the wind has encroached upon Waionui Inlet, the southern shore of which is bordered by a large swampy flat. As the beach flanking the hook on the seaward side has been continuously supplied with sand, the wind has been able to fashion three longitudinal dunes along the length of the hook.

Comparison of the maps of 1880 and 1943 shows that, concurrent with progradation at the bulge to the southwest, the hook has been rounded off and forced south to a maximum distance of half a mile, while an island has been carved from a former headland on the southern shore at the mouth of Waionui Inlet. These facts point to increased wave action in recent times.

The Development of the Three Dune Belts

In seeking for the cause of the rapid growth of the Muriwai foreland in Recent times it is necessary to explain not only the spasmodic development of the three successive sand belts but also the reasons for intervening periods of erosion. Without a doubt much of the detritus forming the dunes was brought to the west coast by the Waikato River from an ultimate source in the central volcanic plateau. This rhyolite debris mixed with the weathering products of the coastal andesite masses as the sediments were carried northwards by longshore currents. Fluctuations in the quantity of material carried to the coast by the Waikato River, perhaps due to upstream development of local base-levels or to variations in the amount of ash spread during volcanic episodes, must have greatly affected the rate of progradation in the dune area north of Muriwai. However, it is doubtful if such fluctuations in the supply of sediment were sufficient to induce alternating periods of extensive deposition and erosion.

An added impetus to progradation of the coast would have been supplied by the recession of sea level that is known to have occurred in Recent time. The Flandrian rise of the ocean, which marked the end of the last glaciation and which submerged the coastline of North Auckland, reached a maximum height at eight to twelve feet above present mean sea level. Recession of the sea in Recent time from that position is evidenced by an abandoned shoreline in the Kaipara

Harbour. Progradation and sand-dune formation concurrent with this fall of sea level undoubtedly added great quantities of sand to the Muriwai foreland, and therefore could account for the development of any one of the dune belts. Nevertheless such a sequence of events fails to explain the intervention of two erosion periods.

It seems most probable that the main cause of dune destruction, and perhaps, in part, of dune formation, has been the climatic cycle. Periods of calm climatic conditions many years in length are known to alternate with similar periods of generally stormy weather. During these latter, translatory waves beating on a previously prograded shore have sufficient vigour to erode the beaches and carry away vast amounts of sand. As pointed out by Munk and Traylor,[7] conditions as they exist along a beach at any given time approach a sensitive balance between erosion and deposition. The balance is profoundly disturbed by any changes in the wave and weather conditions. A disturbed balance in favour of erosion seems to be the case for beaches of the Auckland west coast at the present time. With only one exception all foredunes observed on this coast are undergoing wave-erosion and large areas of sand have been removed from Whites Bay, Anawhata and Bethells Beach. In the two last-named bays, in the absence of sand supply, wide sand-plains have been developed behind the beaches by deflation, while unconsolidated dunes inland from Bethells Beach have shown no movement over the last twenty-five years. Between Karekare, just south of Piha, and Manukau North Head a wide sandy foreland has been cut back to such an extent during the past thirty-three years that at one place the waves of the Tasman Sea now beat

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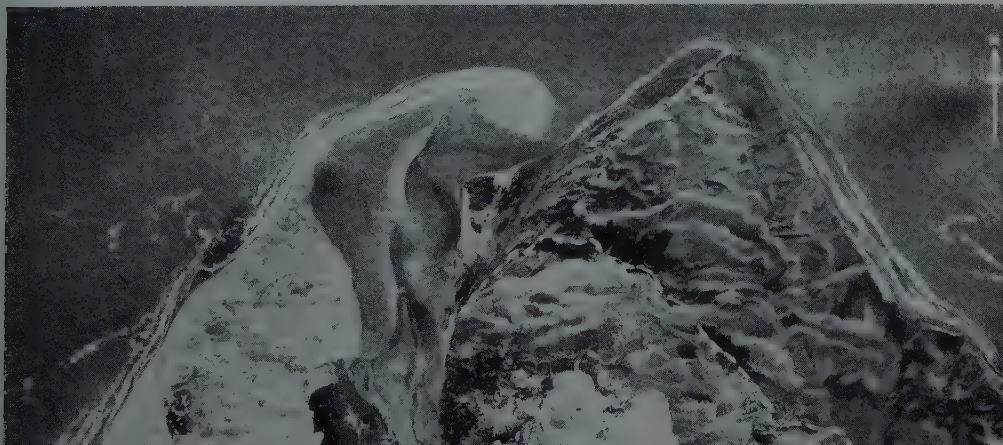
[7] W. H. Munk and M. A. Traylor: 'Refraction of Ocean Waves; A Process Linking Underwater Topography to Beach Erosion.' *Journ. Geol.*, Vol. 55, 1947, pp. 1-26.

Fig. 5. South Kaipara Head enclosing Waionui Inlet. The broken white line marks the boundary between the loose sand of Group III and the Pleistocene bedrock to the east. Scale approx. 1 : 100,000.

Photo: Department of Lands and Survey



against seacliffs, cut in Tertiary volcanics, which in earlier days were protected from the sea by a substantial belt of sand. Muriwai also shows erosion at the seaward edge of its foredune, whilst the 'bulged shoreline' twenty miles further north has been prograded seawards for half a mile, as noted earlier. The bulge is at the site of a natural trap for sand carried north by the littoral current. Beyond it, however, the southward migration of the terminal hook of Kaipara South Head is taken to indicate an increase of wave vigour lasting over a number of years.

THE DUNE CYCLE

During periods when shoreline progradation was dominant, a sand-dune belt was built, but during a series of stormy intervals, when marked regression of the shoreline intervened, the sand supply for local dunes was absent and wandering dunes already formed migrated to leeward as far as circumstances permitted. Therefore a comparison between dune forms shown by successive sand belts gives some indication of any intervals between periods of progradation. In this respect, Group I consists of dunes which moved inland after originating behind a shoreline built out in front of seacliffs carved in the basement Pleistocene sandstone. A long period of retrogression of the shoreline intervened, the early foredune was destroyed and the beach retreated to lie in front of well-developed longitudinal dunes lying at the base of the cliffs, while the high-level dunes inland of these cliffs were developed into extreme forms as long tapering ridges. There next followed a relatively short period of rapid progradation during which at least three successive foredunes (Group II) were built, the oldest lying athwart the longitudinal dunes of Group I. However, before any major migratory dunes were formed, retrogression again stopped the seaward advance of the foreland, and after an indefinite interval a new series of dunes (Group III) was initiated and grew throughout a lengthy period of progradation to form the longest and most modern sand belt on the coast. This sand belt in turn today is showing the effects of wave erosion, the material removed being redeposited at Kaipara South Head.

Dune forms in the Wanganui area seem to be closely comparable with those on the Auckland west coast, for in the Nukumaru Group actively advancing source-bordering lee dunes, parabolic fixed dunes, regular narrow longitudinal dunes and deflated dune areas have been distinguished.[8] The presence of deflated areas on the seaward side of this assemblage, presumably due to lack of sand supply to windward, duplicates the conditions in operation today along most of the length of Muriwai Beach; that is, a disturbed balance in favour of erosion and nondeposition. The interesting anomaly discussed by Fleming of an older set of fixed dunes with their axes of movement more or less at right angles to those of a younger active set has not been met in the Muriwai complex. In the latter area the dune forms show unvaried control by a southwesterly wind, a feature which is characteristic even of parabolic dunes forming the Pleistocene bedrock. The suggestion by Fleming that this anomaly in dune forms at Wanganui is due to different conditions during a 'climatic episode' lends some support to the theory of climatic control that has been advanced to explain the spasmodic generation of dune belts at Muriwai.

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[8] See C. A. Fleming: 'Magnetic Ironsand-ores West of Wanganui'. *N.Z. Journ. Sci. & Tech.*, Vol. 27, No. 5, 1946, pp. 347-365.

NEW ZEALAND RAILWAYS: ROMANCE AND STORY

ALAN MULGAN

> London, 6 August 1953. Prince Charles insisted on seeing the engine of the Royal train before leaving London tonight with his mother for Scotland. . . . Prince Charles took the Queen and Princess Anne the whole length of the platform to see the gleaming engine *City of London*. The young prince talked with the engine driver and his fireman, walked to the front and scrutinised the wheels and connecting rods.
>
> 'Hey, mister, where's your engine?'—Boy's greeting to the first electric train to reach the Hutt Valley, Wellington, 1953.

SO PRINCE CHARLES behaved like a normal English child, or a normal New Zealand one. At that age and later we all wanted to see the engine.[1] But what sort of engine? Prince Charles walked to the 'gleaming engine', and looked at the wheels and connecting rods. If it had been an electric engine—at any rate the sort that runs from Wellington to Paekakariki—to begin with, it would not have gleamed, and to go on with, which is more important, he would not have seen any connecting rods, because there would not have been any, and only the lower parts of the wheels would have protruded from the drab body. This is not 'seeing the wheels go round'. Prince Charles would not have been excited, or at any rate so excited; no normal boy would. Thereby hangs a tale, the tale of this article.

When the change was made on the Wellington-Paekakariki section, I was struck by the contrast between the steam-driven express engine, with its visible suggestion of power coming from its plume of steam and smoke, its puffings and hissings, and the thrust of pistons and revolution of wheels, the two men on the footplate and the gleam of the opened furnace—the contrast between this spectacular articulate and humanised drive of romance, and the drab prose of the smokeless, steamless, rodless, crew-concealed, silent automaton that was partially

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[1] This evergreen interest of boys young and old once prompted me to write about trains in a daily newspaper, and as a result I learned of the existence of the New Zealand Railway and Locomotive Society which 'exists primarily for the purpose of fostering interest in and recording information relating to the railways of New Zealand'. Another stimulus came with the publication of a relatively factual article by Mr. James W. Fox (*N.Z. Geographer,* Vol. 7, No. 2, October 1951, pp. 154-167), and I promised myself I would offer a companion article on the more romantic and personal aspects of the railways of this country. In the writing of this article I have received help and encouragement from the society—for which I am grateful.

Photos: N.Z. Government Railways

Figs. 1, 2 and 3. 'The old order changeth'—from steam to diesel-electric and electric traction in the Wellington suburban area. Electrification has yet to come to Auckland, but diesel-electric locomotives are now operating.

taking its place. As an English rhyme has it:

> The underground train comes out of a tunnel;
> It hasn't an engine, it hasn't a funnel;
> It doesn't make smoke, it doesn't need coal;
> And the driver looks out of a little round hole.

Diesels are not so bad; they make a noise that suggests pulsating machinery. But there, too, the works are enclosed.

Once I had a run from Palmerston North to Wellington during a period of restricted service. We left at five in the afternoon and arrived at about eleven; six hours to do eighty-five miles. It was a cold night, the carriage was unheated, and there was no tea at Paekakariki. We pulled up to let both the three o'clock express to Auckland, and the seven-fifteen 'Limited', pass us. Despite these conditions, perhaps partly because of them, I had one of the railway thrills of my life. I stood on the carriage platform while through the cold, still night the 'Limited' thundered past at top speed only a few feet away. The impression of exultant power, as if the engine was a live thing glorying in its speed and flinging a visible banner aloft in its triumph—this was almost terrifying. If I lived in the country near the main trunk line, I should go down to the track occasionally at night to watch the 'Limited' tearing along. I am sure I would not get the same kick out of it if the train was drawn by an electric or a diesel locomotive.

THE LIFE OF ENGINES

I doubt if proportionately there is anything like the same number of engine 'spotters' here as in Britain—boys and men who pride themselves on being able to identify an engine at sight, as others do a ship of a shipping line.[2] Britain is crowded and highly industrialised, certain expresses are famous for their fast runs, and engines enjoy something like the reputation of racehorses or yachts. This is helped by the practice of naming engines—some, indeed, after racehorses! You may find yourself bowling down towards Lyonesse behind *King Arthur* or *Sir Lancelot,* both of which I saw shunting at Salisbury. I learn from the New Zealand Railway and Locomotive Society that long ago some of our engines bore names, among them *Corsair, Mazeppa* and *Manfred.* The practice was dropped until the Railways Department chose names of historic Maori canoes for railcars, and perhaps it will be extended.

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[2] For an informative and diverting essay on the hobby of railways study in England, see Terence Greenidge: 'Locomania, a Branch-line Holiday', in *Holidays and Happy Days,* London, 1949.

ig. 4. Built in 1875,
Fell locomotive still
auls freight over the
imutaka incline in
953.

Fig. 5. Steam and soft coal spell power as the first regular Auckland-Wellington express passes Porirua Bay in February 1909.

g. 6. Clean and
splendent, an American-
ilt locomotive of 1898
ads the Christchurch-
vercargill express
1905.

Photos: N.Z. Government Railways

THE GIANTS OF YESTERYEAR

However, New Zealanders have their locomotive interest and pride. Mr. Fox referred to 'the heavy oil-burning, eight-coupled J and K classes' as 'triumphs of New Zealand locomotive engineering'. The late S. H. Jenkinson was famous in New Zealand for his design of the Ab locomotive, which has been running for over thirty-five years, and he was known abroad. The length of the working life of many engines is remarkable. When I went over the Shap on my way to Edinburgh in 1926, a fellow passenger told me that a week or two earlier he had done the journey behind an engine built in 1869. Sampling the Rimutaka centre-rail line again in the nineteen-thirties, I noticed a Fell locomotive bearing the date 1875. Perhaps, like the cricket bat in the story, it had had three new handles and two new blades. In freezing works you may find aged railway engines doing light retirement jobs. They could tell many a story.

This brings me to a most illuminating illustration of the personal feeling a locomotive can engender. Last year, 1953, the scrapping of an engine after fifty-four years' service was the subject of a broadcast by one of her drivers.[3] Built for the London and South Western Railway, she ran on express service at speeds up to seventy miles an hour. After the first war she was 'superheated' and reserved for the 'proud service' of drawing Royal trains, in which she hauled all the members of the Royal family. Strong enough for this duty, she was relatively small, and 'like a little runabout car she could go over any roads and fit in anywhere'. 'I for one', concluded her driver, 'am sorry to see her go. I sometimes wish there was a green pasture in which old engines—like old horses—could be turned out to end their days in peace.' A sentiment, I think, that will strike a responsive chord here.

TRAIN AND BUS

Railway lovers must face the fact that their mistress is today suffering something of a decline. I cannot speak personally of air travel, but I would suggest that against its obvious advantages certain drawbacks have to be set; it is the usual price of progress. I have had testimony of the strain, largely through lack of sleep, in the air journey to England. To be expected to go straight into conference when you arrive exhausted is something that the sea traveller is spared. To travel long distances by bus I have a strong objection. Compared with a train, the accommodation is cramped, you can't walk about, reading and talking are more difficult, the frequent turns are upsetting, and there is the psychological urge to drive with the driver. One of my ideas of a good holiday has always been a chair in a train on a fine morning and a suitable supply of reading matter. To read, to doze, to meditate, to look out of the window at the flying landscape —all this makes for a good rest. I know many people don't agree with me; one of my oldest and dearest friends perferred the bus. But the only thing I can find in favour of the bus is that it sometimes takes a higher route and thereby gives you a better view. I saw the farmlands of Southland by rail and road, and the panorama from the road was the wider, more beautiful and more instructive. I do seriously suggest that increase in unrestful travel by air and road, which includes touring by private car, threatens to produce a nasty crop of neuroses.

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[3] See the *Listener* (BBC), 19 March 1953.

Interest of Stations

There is the interest of railway stations en route, greater for some of us than that of termini. There you see goods as well as human traffic, and thus get a line on to industry and other characteristics of a district. Sheep or grain trucks stand on the sidings, and anything from fowls to tulips may be crated on the platform. The station staff know the inhabitants; the station is a focusing point. Engine driver and fireman lean out to gossip. In any country, the further you travel from the big towns the more intimate are these relationships. Recuperating in Devonshire after imprisonment in Germany, during which, through no fault of his captors, he was reduced to a skeleton, a young New Zealand soldier became engaged to a local girl. When, one day, she saw him off on the branch line for a short holiday, the guard admonished her. 'You shouldn't let him go away like that, Miss Mary. He's not fit to travel. He wants feeding up.' 'Meanwhile', she replied sweetly, 'you'd better run, George, or you'll get left behind'! In his solicitude he had forgotten that the train had started, and he had to sprint to catch it.

Irish trains are proverbial for this sort of personal interest, as well as for a general happy-go-luckiness. In one of the Somerville-Ross stories, when the Major, bound for England, wakes at night to find his train stationary and the train and station crew playing cards, both parties behave like gentlemen. 'Mind the goods, Tim!' someone calls out as the train moves off again, and back comes the answer: 'She'll

RAILWAY STATIONS

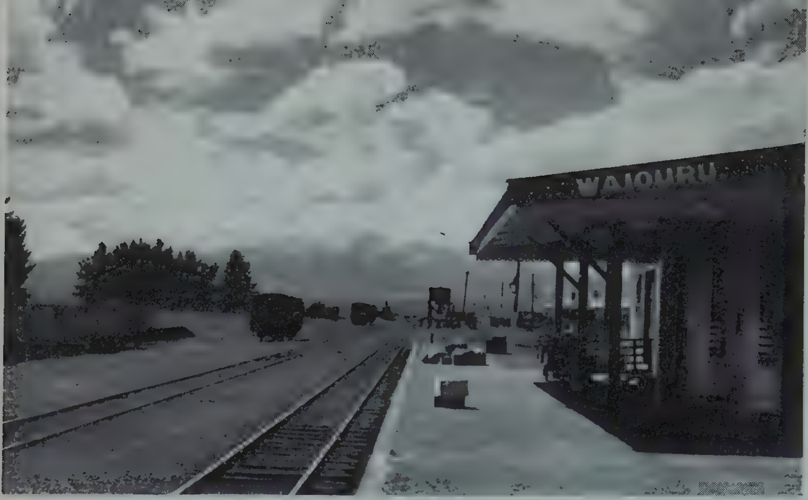
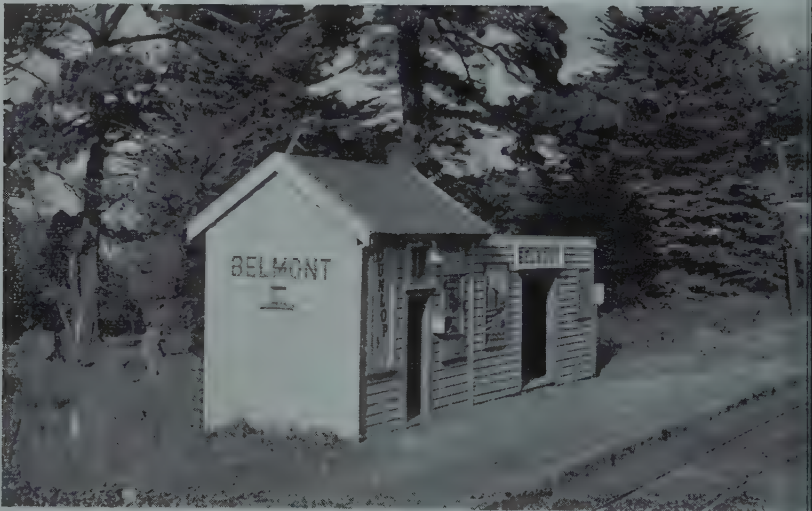


Fig. 7. The calm . loneliness of Waiou New Zealand's lofti station . . .

otos: N.Z. Government Railways



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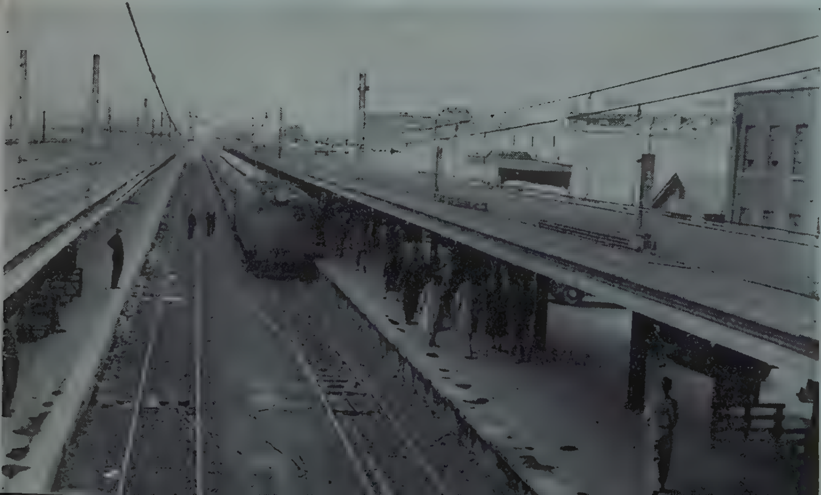

Fig. 9. . . . and th complexity, bustle a untidiness of a termi as the 'Limited' arri in Wellington.

meet her match!' Every Somerville-Ross addict must have sunk back more comfortably into his seat when the film *The Quiet Man* opened as it did, with a train arriving and everybody connected with it advising the stranger how to get to his destination.

I know of no equal to this atmosphere in New Zealand, but that does not say it has not existed. I did know a man who had been in charge of an isolated railway section, and who, being passionately fond of music, had kept a train back because a local society, going up the line for a concert, had left their music at home. Unfortunately the prime minister, Richard Seddon, was on the train. Mr. Seddon was always willing to oblige with 'The Wearing of the Green', but his love of music did not go the length of permitting him to condone this offence, so my friend lost his job. Perhaps on Mr. Seddon's own West Coast, the Ireland of New Zealand, it would have been overlooked.

OUR VARIETY

If oddities do happen, it would be at smaller stations, where the special flavour of local life shows itself. Think of our variety. Think of the difference between, say, Cromwell, gateway to Wakatipu and redolent of gold-getting ('Boy! Colorado!' exclaimed an American marine as he came out of his hotel there one morning and looked round); Rakaia, in the middle of the flatness of the Canterbury Plains; Otaki, steeped in history, dairying and market gardening; Mercer, always threatened by flood but living in many a memory for life-saving cups of tea; and Maungaturoto, where you get a whiff of tidal flats and mangroves. It is good to linger on such platforms. In my boyhood Paeroa was a dismal dump, where the river steamer decanted you to drive by horse coach to the rich mushroom gold town of Waihi. Years later I had a break for tea at the Paeroa railway station on a fine morning, and I thought what a pleasant place it was, neat and gardened, with an air of camaraderie between service and served. Of course you must not feel you are in a hurry. Time was given us to savour life. As Stevenson said, it is better to travel hopefully than to arrive.

There is a wide field for historical and geographical reflection in our railways. This up-on-end land of ours was a challenge to governments and engineers. Our many tunnels, I must admit, constitute one argument for electrification. There is one at Karangahake, between Paeroa and Waihi, which I am told drivers and firemen don't like. Having been nearly suffocated in an excursion train that stopped in the middle of the Lyttelton tunnel on a hot summer day, I can understand their feeling. When I lived in Christchurch many years ago I was told there were people who were deterred from ever going north by the smoke nuisance in that tunnel leading to the port.

If you know your history, you will realise how different things might have been had Vogel been able to carry out his original policy of making the tapped lands pay for lines, and subsequent governments had not built piecemeal in order to keep sweet as many constituencies as possible. I have read that when they decided to go full speed ahead on the main trunk, they had to look for the entrance to the Poro-o-tarao tunnel, which had become hidden by fern. While the railway bridge over the Whangarei River waited for trains to pass over it, people called it 'the gull-roost', and I was told it had to be repaired before it could be used.

Photo: N.Z. Government Railways

Fig. 10. This 'up-on-end land'—the broken country of Central Otago, with its scrub and fern, traversed by a typical mixed train.

Heroes of Construction

The basic heroes of our railways have been surveyors and engineers, and it is no wonder that New Zealanders trained to these professions do so well from China to Peru. Indeed the challenge of their landscape is reflected in the general handiness and adaptability of New Zealanders, which has been so effective in peace and war. The main trunk between Taihape and Taumarunui and the midland line between Springfield and Otira stations are particularly impressive illustrations of engineering difficulties and their surmounting, and of problems in maintenance. It is a pity that nearly all through travellers by train see the middle of the North Island only by night. To realise what planning and construction were like, one should drive under the great viaducts, as one can now over a good road, and try to imagine what the landscape, which grows more open and patterned with the years, was like when surveyors, engineers, contractors and labourers were flung into the wet primitive forest to shift all that earth and to bridge all those ravines.

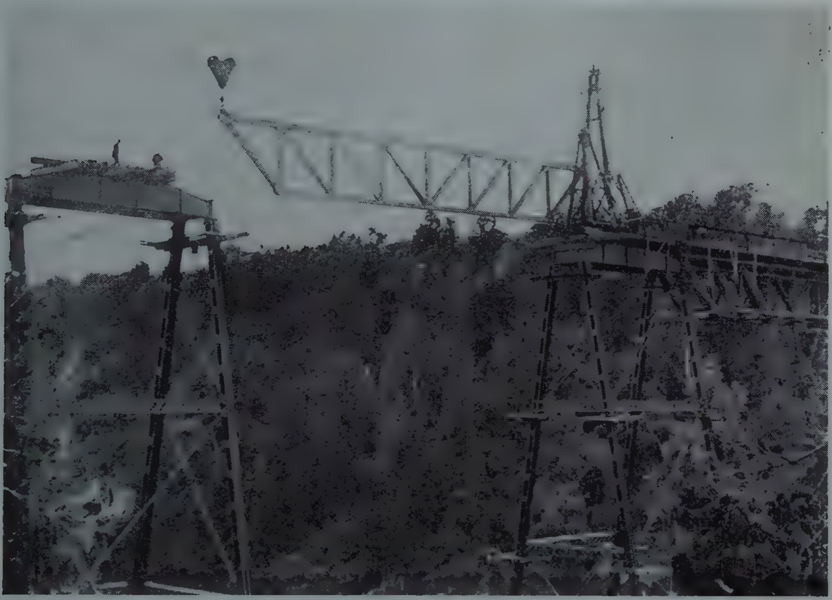

Photo: Andersons

Fig. 11. Building the Makatote Viaduct fifty years ago amid the bush of the North Island hill country.

There must be a mass of material descriptive of that pioneering work buried in the files of newspapers and of the *New Zealand Railways Magazine,* which many of us hope will be revived some day. The story of the building of the Makatote Viaduct, 300 feet high, is partly told in the centennial book of one of the largest engineering firms in New Zealand.[4] In 1905 the country was densely forested, and there was not even a horse track to the site. Transport of heavy fabricated girders being impossible, the engineers built an elaborate workshop on the spot, 285 feet long and thirty feet wide. In this, steel work was also put together for three bridges south of Makatote. The photographic record of the Makatote project in this book, from the clearing of the site by bullock teams, through the placing of legs and spans in position, to the completed structure, is superb. I don't know anything of the kind that brings that remote and strange past so vividly before us.

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[4] *One Hundred Years: An Account of the Founding, Development and Progress of Andersons, 1850–1950,* Christchurch, 1950.

'Unremembered Legion'

Nor should we forget the men who built the railways with pick, shovel and wheelbarrow, living in bush camps of tents and shacks that would not be tolerated beside the township standards set up by the Department of Works for its employees today. There were some queer goings-on in those remote out-of-mind camps. A journalist who spent a fortnight in one in search of copy told me that the first night two of his mates quarrelled, and one threw a knife neatly to pin the other to the floor through the foot. The assailant had been a knife-thrower in a circus. Not long ago, as we passed a bulldozer at work, I asked a former Public Works engineer what he reckoned these new methods saved in time. 'About seventy percent,' he replied. Denis Glover's fine tribute to the road navvy, 'The Road Builders', is equally applicable to the railway digger.

> An unremembered legion of labourers did this,
> scarring the stubborn clay, fighting the tangled bush,
> blasting the adamant, stemming the unbridled rush
> of the torrent in flood, bridging each dark abyss.
>
> Their tools were pitiful beside the obdurate strength of the land:
> crosswire of the theodolite, pickpoint, curved shovel,
> small tremor of a touched-off charge, but above all
> the skill and strength, admirable in patience, of the hand.

A few years ago, an English visitor of some standing referred on his return to the 'Limited' being 'invariably late', which of course it is *not*. It was not only that he was grossly inaccurate, but that he took no account of grades and curves and gauge and the unstable character of the high country, conditions very different indeed from those of British running. For the 'Limited' to cover 425 miles in a little over fourteen hours with the degree of punctuality it achieves, is a good performance.

Fig. 12. The sunlit informality at Clyde, Central Otago, as all lend a hand in the loading of fruit . . . .

If you wish to read about the working of a railway line from the station platform point of view, I commend the chapter in which A. Leigh Hunt describes his time with the Manawatu Railway Company, always bearing in mind that the company seems to have operated somewhat more economically than the government.[5] With an enterprise and courage that recalls the building of the Lyttelton tunnel by infant Canterbury, a group of Wellington business men stepped in where the government hung back, in the depression of the 'eighties, to give Wellington the link with the Manawatu that it so desperately needed. Mr. Hunt's lively pages are a sociological as well as an economic document. At nineteen he was a relieving stationmaster and the whole staff—working the trains, selling tickets, and keeping the books—at thirty shillings a week. Those were the days of handbrakes, and he gives a vivid picture of climbing over wet sheep trucks in a howling southerly to steady the train by the waggon-top gear. The

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[5] A. Leigh Hunt: *Confessions of a Leigh Hunt,* Wellington, 1951.

Fig. 13. . . . whilst at Ashburton in Canterbury an engin
crew prepares a Ja class locomotive for its next ru

Photos: N.Z. Government Railways

Manawatu Railway Company operated without a serious accident. It introduced dining cars, and many of us regret that the Railways Department, after running these for some years in both islands, felt obliged to discontinue them. Also, if I remember rightly, the company paid its shareholders nine percent.

GEOGRAPHY AND HISTORY

Our railways are conditioned by our geography, and are woven into the stuff of our history. They teach both. I once described the formation of Cook Strait as a major disaster, because it split the fabric of the country in two, and helped to produce political, social and economic divisions that have lasted to this day. The railways system had to be developed on either side of the break, and it looks as if nature, plus air travel, would prevent the two systems from ever being linked by train ferry. One reason why Canterbury and Otago drew more closely together than Wellington and Auckland was that rail connection was much easier. The isolation of Auckland did not begin to be substantially reduced till the main trunk was completed in 1908. Thank goodness, however, the differences in gauge disappeared early.

The interest of travel is greatly increased if you regard a journey as a tour through history. Every town or district has its story. Mercer bears the name of an officer who fell at Rangiriri; another station, Hamilton, started as a military settlement and is now probably the first dairying town in the world. The 'Limited' crosses the line beyond which it was once death to the European to venture. Marton is called after Captain Cook's birthplace. Feilding is the centre of one of the most successful of special immigration settlements; Palmerston North grew out of a clearing in heavy forest, where Scandinavians were among the early settlers. The building of the Lyttelton tunnel was a drama of vision, resolution and scientific knowledge. Ashburton recalls Grigg of Longbeach, and Springfield the days of horse-coaching over Porters Pass and Arthurs Pass, and so on. To those who have ears to hear, the train is a teacher, ready to speak in poetry as well as prose.

TRANSPORT IN NEW ZEALAND: A REVIEW

WILLIAM H. WALLACE

TRANSPORT is a basic function, not merely a supplementary service. Measured in terms of either the amount of labour or the energy which it consumes, this activity bulks large in the world's economy. The movement of people and goods is essential to the utilisation of all areas, particularly of those with highly-specialised economies. As the Minister of Transport has recognised, New Zealand's production is dependent upon transport facilities, and it is fundamental that they be expanded along with the dominion's economy.[1] In the year 1952-1953 an all-time record volume of freight traffic was handled by the New Zealand transport system. The size of this movement is evidence not only of the rising tempo of the country's economic activity but also of the ability of the several transport agencies to cope with ever-increasing demands. An investigation of these facilities and their functions is not only timely but essential to an understanding of New Zealand.

Fundamental changes are taking place in the internal transport structure of New Zealand. Railways remain the basic element of the industry but with the rapid development of air and, more particularly, of road carriers, they are becoming relatively less important. This trend is most evident in the movement of passengers. Statistics published by the Transport Department indicate that licensed road passenger transport now earns revenues which are nearly three times as great as those obtained by the railways for similar services. A considerable increase in the volume of goods offered for haulage and the inherent advantages of railways for handling bulky commodities have prevented an equally profound change in freight traffic. Here too, however, the relative roles of road and rail are altering and must be subjected to reexamination in the light of present conditions. The 'thirty miles railway restriction' is being criticised by truck interests as outmoded.[2] Yet it would be most unwise not to make the most effective possible use of railways in which the people have invested tremendous sums of money by permitting the wasteful duplication of facilities which must also be largely provided at public expense. A rational solution to this dynamic problem will require constant study in the years to come.

RAIL TRANSPORT

For the railways, the year 1952-1953 was in several ways a record period. More tons of freight were hauled than in any year since the *Pilgrim* first chuffed from Christchurch to Ferrymead in 1863.[3] Expenditures reached a new high level, but so did revenues, and the system made a small profit on its operations. Once again, however, the income was too small to meet the interest charges on the capital invested. The North Island lines contributed nearly twice as much to railway revenues as those of the South Island and as usual had a more favourable operating ratio.[4] Only the isolated Nelson section suffered declining fortunes. This hapless line had operating expenses which were nearly three times as large as its revenues!

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[1] 'Annual Report of the Transport Department', *Append. Journ. House of Repres.* (H-40), Wellington, 1953, p. 1.

[2] The 'thirty miles railway restriction' requires that, with certain exceptions, all goods shipped for distances in excess of thirty miles shall be handled by the railways.

[3] 'Railways Statement', *Append. Journ. House of Repres.* (D-2), Wellington, 1953, p. 2.

The railways continue to receive most of their revenue (eighty-four percent) for hauling freight. Goods traffic was at a very high level during the first part of the year, but as the restriction of imports was felt in New Zealand, freight movements sank to a low level. Traffic volume was also adversely affected because many lines were temporarily put out of operation by such typically New Zealand phenomena as floods, slips and washouts. Less significantly, the amount of freight handled was reduced by the continuing diversion of goods to highway and sea carriers because of a shortage of locomotive crews.

Passenger traffic was slightly greater than in the preceding year, but still below the levels of the 1940's and earlier years. It seems unlikely that this business will ever again reach the volume handled in the period before road and air competition became so effective.

Operating Problems

Today the railways face a number of problems. Most serious are the difficulties connected with staff. One reason why labour is a major concern is the fact that well over half the total cost of running the railways is represented by wages. Thus labour is basic to the expenses of railway service, and any changes in either its cost or efficiency necessarily exert a profound effect upon railway rates and/or subsidies. More pressing, however, is the chronic difficulty experienced in maintaining an adequate working force. As the Railways Commission states: 'Any serious shortage of staff is cumulative in its effect, in that long hours and excessive night shifts make railway work less attractive; this tends to increase the loss of staff by resignation and retard recruitment.'[5] Fortunately, this problem is becoming less acute as the national labour shortage abates.

Recurrent large railway deficits during a period of national prosperity have caused grave concern to a government whose policy is that the cost of railway transport shall be borne, so far as possible, by the user. To meet this problem the New Zealand Railways Commission has been established as a means of securing effective management. This new commission has already concluded that there is no spectacular way to cut railway costs or to increase revenues. Deficits will continue unless increases in railway costs are incorporated into railway charges soon enough to cover the additional expenditure. Evidence of the disparity which has been permitted to creep into this fundamental relationship is shown by the fact that since 1939 railway expenditure has grown by nearly two hundred percent, whilst in the same period charges have increased by barely eighty percent.

Ever-increasing competition from road carriers is causing the railways serious concern. Long-distance traffic is the lifeblood of the system and the management is determined that it shall continue as the primary function of the railways. Branch-line and short-haul traffic is a somewhat different proposition. Many of the branch lines are uneconomic, not only because their revenues do not meet the costs of their operation, but also because they engage equipment and labour which could better be used for other purposes. The future of such lines is a major problem. In all cases a detailed study of the value of these railways as feeders to the system, of the possibility of more economical operation, and of the availability of alternative means of transport is being conducted before action is decided upon. It would seem that here is an excellent opportunity to coordinate road and rail transport to the benefit of the entire community.

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[4] An operating ratio is the ratio between operating revenues and operating expenses.

[5] 'Railways Statement', *op. cit.*, p. 5.

The serious shortage of equipment which has plagued the railways during the past decade is now close to solution. Deliveries from the United Kingdom, and construction within New Zealand, will shortly assure adequate quantities of both motive power and rolling stock. Although the basic type of motive power which will be employed in the future is not yet clearly indicated, certain trends are evident. The steam locomotive will relinquish its dominant role, and diesel traction will be a major factor. Although there are objections to operating the railways with imported fuel, it should be recognised that petroleum is already the source of power for a considerable part of the steam trains and for *all* the road and air transport in the country. The diesel locomotive will produce more transport per unit of fuel than any of these. Electric traction is also replacing steam power on the railways. In the Wellington area electrified operation was extended to the Hutt Valley and more new units were put into service.

ROAD TRANSPORT

The rapid growth of highway transport in New Zealand can be gauged by the recent increases in numbers of motor vehicles, in fuel consumption and in expenditure on roads. Automobiles, including taxis and rental cars, are dominant in passenger transport today.[6] These machines cover more vehicle-miles than any other class of road user. On the other hand, it is trucks, particularly heavy trucks, which do most of the transport work measured in gross ton-miles and account for the largest part of New Zealand's motor-fuel consumption.

The provision and maintenance of roads to meet the demands of a rapidly-growing volume of heavy traffic is now a major problem. Ever greater numbers of roading authorities are reducing axle-load limits. Indeed, the basic axle load is now permitted on less than one percent of the rural road net. Bridges present even more pressing difficulties. During 1952-1953 the number of bridges from which heavy vehicles are restricted showed a further marked increase. Clearly, the present road system is not suited to continuous heavy traffic and it is obvious that a considerable expenditure would be needed to make such usage practicable.

Highway accidents are also a serious problem. In terms of numbers of highway deaths per thousand vehicles on the road, New Zealand is a slightly less dangerous place in which to motor than the United States and considerably safer than either Australia or Great Britain. However, a measure which takes into account the *actual*

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[6] 'Annual Report of the Transport Department', *op. cit.*, p. 8.

human traffic on the roads, such as 'highway fatalities per person-mile', would provide a much more valid basis for such comparisons. Christchurch is the most dangerous of New Zealand cities in terms of accidents per head of population. Auckland is only slightly less perilous, but Wellington and Dunedin are safer than most of the smaller cities. Some social scientists may be able to suggest correlations between the times of maximum accident frequency and certain aspects of the New Zealand way of life—between the hours of five and six on weekday afternoons and between seven and eight on Saturday evenings.

SHIPPING

No country has a higher per capita value of foreign trade than New Zealand.[7] As a result external transport is of vital concern. Ships still carry most of the goods to and from the dominion, but airlines now handle forty-two percent of the overseas travellers. Well over half of all foreign commerce is with the United Kingdom. Most of the remainder is carried on with other countries of similar technology and culture such as the United States, Australia and Canada. Overseas trade moves primarily across the wharves of the four main centres. Auckland alone handles forty-one percent of all foreign cargo, and together with Wellington, Lyttelton and Dunedin it accounts for more than four-fifths of New Zealand's external sea traffic.[8]

Despite the fact that no part of New Zealand is far from the sea, that most of its economic activity takes place in coastal areas, and that it is divided in two by Cook Strait, coastwise shipping is relatively unimportant. The total tonnage handled by these ships is only sixteen percent of that moved by rail. Coastal movements are primarily interisland or interregional rather than truly local. Nearly three-quarters of all coastal traffic moves through the four main centres and the coal ports of Westport and Greymouth. The significance of Cook Strait to internal shipping is evidenced by the fact that the four ports most directly concerned with ferry services across this channel handle well over one third of New Zealand's coastwise cargo.

The relationship between port function and hinterland production is well illustrated by the commodities which move out of the various harbours. Auckland is the foremost shipper of both meat and butter; Wellington leads in cheese traffic; Napier in wool. Equally distinctive is the leadership of Westport and Greymouth in coal shipments.

AIR TRANSPORT

Air carriers are the newest feature of New Zealand's transport system, but because of the inherent difficulties of surface movement in this country, it is likely that the aeroplane will play a major role in the future. Already a large part of international passengers move by air, and domestic services are making steady inroads in long-distance sea and rail traffic. New Zealand has not been backward in developing this type of transport. Despite the dominion's small population and area the total amount of air transport performed in this country during 1951 placed it seventeenth among the fifty-seven states which are members of the International Civil Aviation

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[7] *N.Z. Official Year-Book 1953*, Wellington, 1953, p. 246.

[8] *Ibid.*, p. 314.

Organisation. During this same year New Zealand was second only to Australia in the amount of air transport performed per head of population.[9]

In at least two types of air transport, New Zealand has been a pioneer. The unique rail-air freight service across Cook Strait is a good example of the way in which the disabilities of surface transport in this country offer unusual opportunities for air carriers. This 'ferry' links the separate railway systems of the North and South Islands and now accounts for three-quarters of the dominion's internal air freight tonnage.

Aerial topdressing, already important in extensive pastoral farming, continues to expand rapidly. During the year 1952-1953 the amount of fertiliser distributed increased by sixty-three percent, and the acreage topdressed was seventy-one percent higher than in the previous year. Such diverse commodities as grass seed and rabbit poison are now being spread from the air. The experimental backcountry freighting of fencing and general materials by 'aerial pack-horse' suggests the possibility of a new role for aircraft in the development of previously inaccessible areas.

Domestic air-passenger traffic increased only slightly during 1952-1953, and the volume of mail and freight fell sharply from the record levels produced by the waterfront strike of 1951-1952.[10] International movements also declined; passengers were more than twelve percent fewer than in the previous year. The TEAL routes across the Tasman Sea are by far the most important of New Zealand's external air links. More than three-quarters of all overseas air travellers fly this way as does most of the mail and freight—a vivid demonstration of New Zealand's British ties.

In stark contrast to the TEAL monopoly over this large traffic flow are the three airlines which compete for the much smaller transpacific business. Among these BCPA carries more passengers (fifty-six percent of the total) than the other two carriers combined, but PAA is even more dominant in the movement of freight. CPA is as yet a minor factor in this highly competitive situation. It is surprising that both the NAC and the TEAL South Pacific services were patronised by more travellers than were the services of *any* transpacific carrier.

Each of the transport agencies has its peculiar problems, and all are undergoing changes. In the cases of railways and shipping, old but still basic services are adapting themselves to changing demands and technology. Air and road transport are in a period of rapid growth, striving for economical exploitation of their exciting possibilities. All four parts of the transport system have roles to play in the future of New Zealand. The determination of their respective spheres is a complex question to which no answer can be permanent. Objective study and careful planning are needed if waste and chaos are to be prevented.

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[9] 'Annual Report of the Air Department', *Append. Journ. House of Repres.* (H-37), Wellington, 1953, p. 12.

[10] 'Annual Report of the New Zealand National Airways Corporation', *Append. Journ. House of Repres.* (H-35), Wellington, 1953, p. 11.

GEOGRAPHY IN SCHOOLS . . . .

5. *A BRIEF HISTORY OF GEOGRAPHY IN THE PRIMARY SCHOOL*

N. H. Whatman and C. M. Herbert

TODAY it is safe to say that geography as a study of 'what places are like' is firmly established in the university, the teachers' colleges, and in most post-primary schools in New Zealand.[1] While many primary-school teachers, particularly those who have had recent contact with the university and the teachers' colleges, are teaching geography from this viewpoint, many others cling to an approach which belongs to the past. Reference has already been made in the *New Zealand Geographer* to recent primary-school refresher courses at which some lecturers advocated ideas which took no cognisance of recent changes.[2] This failure to take notice of or to understand the 'new' geography, is in marked contrast to the otherwise general acceptance of modern educational principles.

The purpose of this note is to trace the changes in the teaching of the subject in New Zealand primary schools since the establishment of a national system of education in 1877. Such a review may foster a better understanding of the present unsatisfactory situation in which the teaching of geography in our elementary schools finds itself. An examination of available records reveals that apart from the current viewpoint there have been three distinct approaches to the teaching of the subject. They may be summarised by applying to them the terms: (1) Capes, Bays and Definitions; (2) Physiography; and (3) Environmentalism.

CAPES, BAYS AND DEFINITIONS

Under the approach to school geography most appropriately labelled 'Capes, Bays and Definitions', children memorised the names and location of the 'geographical' features of the countries of the world. In addition they were made to remember definitions of such things as isthmus and archipelago which were considered essential to the proper understanding of geography.

In the first official primary-school syllabus of 1878 the subject matter of geography was clearly defined.[3] Standard 2 pupils were to have 'a knowledge of the meaning of a map, and of the principal geographical terms'. In Standard 3 they were to learn 'the chief towns of New Zealand, the colonies and towns of Australia, the countries and capitals of Europe, and the principal mountains and rivers of the world'. The Standard 4 prescription included 'a knowledge of the countries of the world with their capitals, and of the principal seas, gulfs, mountains, rivers, lakes, capes, straits, islands and peninsulas on the map of the world—the drawing of rough maps of New Zealand, with one set of principal features, *e.g.* capes or towns or rivers'.

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[1] This definition of geography is to be attributed to Dr. K. B. Cumberland. See, *inter alia,* K. B. Cumberland: 'The Nature of Regional Geography', *Post-Primary School Bulletin,* Vol. 4, No. 8, p. 162.

[2] See the note 'Refresher Course in Social Studies' in 'Geographic Notebook', *N.Z. Geographer,* Vol. 8, No. 2, October 1952, p. 177.

[3] *N.Z. Gazette,* Wellington, 9 September 1878.

In the amendments to the syllabus of 1887 this prescription with its emphasis on the memorising of facts was retained.[4] In the upper classes, Standard 5 pupils were expected to know the 'names and positions of places of political, historical and commercial importance in New Zealand, in Great Britain, Ireland, and the European continent'. In Standard 6 this was further extended to 'Asia, North America and the British Possessions'.

It would appear that this conception of geography was current in New Zealand schools from the earliest organisation of school education. In the preface to a *School Primer of the Geography and History of Oceania for Young People* prepared by John B. Park under the patronage of the Otago Education Board and published in 1866, it is stated that since 'geographical knowledge is, to a great extent, a collection of facts treasured in the memory, it is obvious that the more systematically these facts can be arranged and presented to the mind the more likely they are to be remembered'.[5] There follow comprehensive lists of bays, capes, islands, chief summits, plains, lakes, rivers, towns and other such features in each island. These lists are arranged on the page so that they appear in their respective compass quarters thus—

CAPES IN STEWART ISLAND

N
Black Rock Point and Saddle Point

W
Weather Point

E
East Head, Point Adventure

S
Southwest Cape, South Cape, Seal Point

In addition to these lists of 'physical and political facts to be learned' covering, in the case of New Zealand, eleven pages, there are as many pages devoted to 'historical and descriptive remarks'. These were to be read in class whilst the pupils were learning the basic facts mentioned above—a mere sugar coating to the pill. As the preface states 'by this method it is confidently believed that the geographical lessons will be made highly interesting, particularly if the places referred to in these remarks are pointed out on the map as they occur'.

In spite, however, of the emphasis on memory work results were disappointing to inspectors. In his annual report of 1878 the senior inspector of the Otago Education

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[4] *N.Z. Gazette,* 7 July 1887, pp. 880–887.

[5] J. B. Park: *A School Primer of the Geography and History of Oceania for Young People,* Dunedin, 1866.

Board stated: 'This subject remains as unsatisfactory as formerly.'[6] In Westland it was reported that 'a written examination was held for the first time with disappointing results, but the oral results were no better'.

In contrast with the present syllabus which sets out the content and method of teaching 'Social Studies in History and Geography', the teacher's task during this earlier period was quite clear-cut. The 'Capes and Bays' approach was most systematic and orderly. In the light of the present approach to geography, however, there was no provision for many things which should have found a place. The names of places were important and so were their products, but details concerning the life of the people in these places were of very little significance. No one would advocate a return to such a barren approach, but anyone in contact with the products of our present school system must be constantly appalled by the inability of most training college and university students to locate with any accuracy important places and features in New Zealand. Such experience is obviously not isolated.[7]

PHYSIOGRAPHY

At the end of last century came the second approach, in which the emphasis was placed heavily on the physical aspects of geography. This change, which like most others in the educational system of this country, sprang from somewhat earlier developments overseas, was accidentally strengthened in New Zealand by the variety of physical features available for study in a small area. As J. W. Gregory stated in his introduction to Marshall's *Geography of New Zealand:* 'The fortunate inhabitants of New Zealand should be geographers by instinct; for New Zealand consists of a collection of geographical models, from which true geographical ideas should be unconsciously absorbed. There is no other land area of equal size which is so varied and so complete. It is unique from the combination of the variety of its landforms, the clearness of their development, and the simplicity of their arrangement.'[8]

The appearance at this time of the first and for long the only textbook of New Zealand geography was in itself a landmark. As early as 1878 the senior inspector of the Nelson Education Board had stressed the need for a text written for New Zealand schools.[9] Although Marshall's book filled the need for a New Zealand text, its form reflects the major change that had taken place in the teaching of geography.

In his preface Marshall wrote: 'Dr. H. R. Mill, in a paper on the scope of geography, has lately defined it as the science that deals with the forms of relief of the earth's surface and with the influence that these forms exercise on the action of all other phenomena.' Further on he claimed that 'it was with the idea of describing New Zealand according to the spirit of the new geography that this book was written.'

The importance attached to physiography may be judged from the fact that some 242 pages of the *Geography of New Zealand* were devoted to a description of mountains, plains, rivers, glaciers, lakes, coasts, fauna and flora of New Zealand, but only seventy pages were used to describe political and commercial geography. As a legacy from the past there were appendices which included lists of towns, lakes, rivers and mountains.

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[6] *Append. Journ. House of Repres.*, (H-1), 1878, p. 72.

[7] See the note 'Place Geography' in 'Geographic Notebook', *N.Z. Geographer,* Vol. 8, No. 1, April 1952, p. 73.

[8] P. Marshall: *The Geography of New Zealand,* Christchurch, n.d. [1905], p. 1.

[9] *Append. Journ. House of Repres., loc. cit.*

The primary-school syllabus of 1904, like its predecessor of 1877, was quite specific as to what was to be taught at each level.[10] There were to be three courses in primary-school geography. Course A, which was a compulsory core in each class was physical and mathematical geography. This was to be taught continuously from Standard 3 to Standard 6. Course B, which was also compulsory, was awarded less time. It was to be spread over two, three or four years so that every child passing through Standards 3 to 6 should receive at least two years' instruction therein. The object of this course was to show, 'as far as is possible for the minds of children to see it, the connection between physical geography on the one hand, and political and commercial on the other'. Course C, which was optional, was largely 'capes, bays and capitals geography'.

In Standards 5 and 6 considerable emphasis seems to have been placed on the teaching of mathematical geography. There were sixteen separate sections to be taken in a connected logical order. Recent experience would suggest, that while all the facts listed may not be necessary in the geographical education of a Form II child, all post-primary pupils on entering teachers' training colleges might be expected to know that day and night result from the earth's rotation and not from the daily movement of 'the sun round the earth'.

VARIATIONS IN PRACTICE

The amendments to the syllabus in 1913 retained most of the 1904 content but streamlined the procedure of teaching it.[11] Courses A, B and C were replaced by one course with physical and political sections. It was stressed that neither portion of the subject was to be neglected. Although the syllabus still emphasised the importance of physical geography there were suggestions in inspectors' reports at the time that in practice changes in emphasis *were* taking place.

The Wellington senior inspector reported: 'The commercial side of geography has suffered in the past from the greater prominence given in the syllabus to mathematical and astronomical requirements; but the rapid development of the means of communication between different parts of the world, and the marvellous increase of transport, trade, and of interchange of commodities, now more than ever demand that our schools provide ample instruction in this branch of geography, and we shall gladly welcome any modifications of the regulations which will enable the subject to receive the attention that its importance deserves'.[12]

The Otago report of the same year included the following statement: 'Teachers have given more prominence to physical, social and commercial geography than to the mathematical section. Of this action we thoroughly approve, holding as we do that intensive teaching in mathematical geography should be relegated to the secondary schools.'

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[10] Supplement to *N.Z. Gazette,* 21 January 1904, pp. 266–296.
[11] *ibid.,* 16 December 1913, pp. 3685–3692.
[12] *Append. Journ. House of Repres.,* (E–G), 1913, p. 12.

These particular changes, however, were not to find official expression in the next syllabus issued in 1919.[13] This grouped geography with nature study, elementary science and home science under the general heading of 'Man and Nature'. History, which in the current syllabus is linked with geography, under the general heading of 'Social Studies' was, in 1919, linked instead with civics and moral instruction under the separate heading of 'Man and Society'.

While there is a great deal of interest and value in any study of the physical environment, this alone is not the true function of geography. As a subject, physiography, like the earlier capes and bays approach, largely ignored the work of man.

Environmentalism

The next major syllabus revision came in 1928 when for the first time important new methods were advocated.[14] They included: (1) first-hand studies of the school neighbourhood; (2) informal teaching methods; and (3) more emphasis on the humanistic approach.

The new syllabus was readily accepted by teachers since it set out in carefully graded steps the material to be taught at each level, and gave detailed instructions on methods and approach. There were some twenty-four pages in the syllabus devoted to geography, whilst history teaching was given only one third of the space. In addition there were nearly three pages in the bibliography of recommended books on method and content. A teacher could be in little doubt about what should be taught and how he should teach it.

Despite these advantages, however, the whole philosophy of the syllabus in geography, in the light of present concepts, was fundamentally unsound. In the very first sentence lies the key to this viewpoint recommended. The unscientific approach which it highlights is best known as 'environmentalism'. 'One of the main aims in the following syllabus is to broaden and deepen the child's knowledge of, and interest in, those forces of nature that *determine not only man's industries but also his racial characteristics*.'[15]

For the first time in New Zealand primary schools human geography was given the major emphasis, but it was to be approached always through a study of relief and climate and with a limited and unscientific purpose in view. 'Throughout the whole course it is highly desirable that the humanistic side of geography should be stressed' the syllabus stated. In the next paragraph it set out how this should be done. 'Man in order to procure food, shelter, clothing and other necessities of modern civilisation, must work. What work does he do? Largely the work that natural conditions, *e.g* climate or surface, permit him to do. He finds his activities circumscribed—nay, largely determined by—these natural forces, and he becomes a hunter, a farmer, a miner, a herdsman.'

With these principles clearly enunciated at each level the teacher of geography was exhorted to establish geographic laws which determined man's activities wherever he happened to be on the earth's surface. For New Zealand the most clear-cut examples of climatic control were established for the South Island with the familiar east-west profile with the wet western slopes of the Southern Alps and the dry plains in the east giving rise on the one hand to dairying, timber-milling and coal mining in Westland, and in Canterbury to sheep rearing and wheat cultivation. And so a geographic law was established: West, wet—therefore dairying; East, dry—therefore sheep and wheat. The application of this law to the North Island was a simple deduction which any ten-year-old child might be able to make.

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[13] *N.Z. Gazette,* 18 September 1919, pp. 2883–2897.
[14] *Syllabus of Instruction for Public Schools,* Wellington, 1928.
[15] *ibid.,* p. 37.

The unsatisfactory nature of this approach to the study of the geography of New Zealand may be gauged from the fact that in 1927-1928 there were six times as many dairy cows in Canterbury as there were in Westland, and that in the Rangitikei-Manawatu area, west of the ranges, there were more than ten percent of the dominion's breeding ewes. But the syllabus brushed these important facts aside in these words: 'Broad principles alone should be studied and should not be departed from because there happen to be a few sheep in Westland or a few cows in Canterbury.'

THE FALLACY OF 'LAWS'

There were, however, areas in New Zealand which the syllabus could not fit very happily into the picture in spite of this 'fundamental geographic law'. 'Southland, part of Otago and Auckland do not enter into the scheme and will require separate treatment. In Southland especially the lines of demarcation are wanting—there are forests like those of Westland, dairy-lands like those of Taranaki, sheep country like that of Canterbury, extensive brown coal deposits, and formerly deposits of gold like those of Westland.'

The laws could be applied to other countries with equal, if doubtful, value and validity. 'Similar conditions will be encountered in the study of other countries, *e.g* North and South America, western Europe, India, and pupils should be encouraged to apply their knowledge *to forecast, as it were, the occupations of the people*.'[16]

The ultimate was reached—and in some schools the same technique is still used—when the children were asked to apply these laws to imaginary continents. It is not difficult to understand why this kind of geography soon disappeared almost entirely from the secondary school examination curriculum, why geography so defined could have no place in the university, and why generally the subject was widely discredited.

While there are obviously places and peoples where adjustment to environment is apparent, no thinking person could accept the physical environment as the determining factor in man's activities everywhere on the earth's surface. For the primary-school child this oversimplification was intended to assist his learning by systematising knowledge. The emphasis was, however, so strongly on the incomplete and unsatisfactory answering of the question 'Why?' that the true function of the ancient and classical study was lost.

The 1928 syllabus was reprinted in 1937 but in that year there took place a series of conferences under the auspices of the New Education Fellowship which were to have far-reaching effects on all primary-school teaching in New Zealand. Almost overnight the 1928 syllabus which had guided teachers of geography so closely was set aside. Unfortunately nothing was designed to replace it, and many teachers naturally followed in their teaching of geography the principles with which they were now thoroughly familiar. The teaching of the subject became extremely woolly and results were too often simply judged by the number of attractive wall charts or projects which adorned the classroom.

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[16] *ibid.*, p. 150.

With the intervention of the war the issue of a new syllabus was unavoidably delayed, and it was not until 1946 that its outline was completed and circulated among teachers for comment. It was a revised and considerably changed version which was finally issued as a syllabus in 1947,[17] This latest and current syllabus sets forth clearly the aims of teaching 'Social Studies in History and Geography'. They may be briefly summarised as:

(1) to awaken the child's interest in the physical setting of his neighbourhood and of the world;
(2) to give children an understanding of the interdependence of all human beings;
(3) to set forth ideals of brotherhood, truth, justice, tolerance, courage, unselfishness and responsibility to others;
(4) to foster appreciation of one's district and country past and present.

From the point of view of the new approach in geography the syllabus offers little guidance, and many teachers through no fault of their own are teaching environmentalism in the belief that it is still as the 1928 syllabus so definitely states, 'the modern viewpoint of geography'. But as students go out from the university and teachers' colleges the viewpoint of what is at once both the most recent and the most ancient and classical concept of geography should gradually become established as the only satisfactory approach to the study of the earth as the home of man.

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[17] *The Primary-School Curriculum,* Wellington, 1947.

GEOGRAPHIC NOTEBOOK

CONTRIBUTORS TO THIS ISSUE. In several quarters of Australia and New Zealand, 1953 saw renewed expressions of interest in Antarctica. Plans were developed in Australia for an officially-sponsored expedition to Australian Antarctic territory. In New Zealand there was little governmental interest or action. However, under the auspices of the New Zealand Antarctic Society the book *The Antarctic Today* was published and was widely welcomed and acclaimed. This book was edited by Mr. Frank Simpson, who in this issue of the *New Zealand Geographer* contributes a simple, introductory account of the Ross Territory, New Zealand's own particular sector of Antarctica. Mr. Simpson is on the staff of the *Evening Post,* Wellington, and in the preceding number of the *New Zealand Geographer* contributed an article on Kapiti Island.

Two members of the staff of Auckland University College—one a geologist and the other a geographer—present in this issue reports on work in their respective fields which fittingly represent the different viewpoints of the respective sciences. Dr. Brothers is Senior Lecturer in Geology and Mr. Bryan H. Farrell is Lecturer in Geography.

Railways have a fascination for young and old—a fascination compounded of awe at the majesty of steam power and of respect for the inventiveness of man which produces such mechanical monsters, be they steam, diesel or electric. Yet without men railways would be so much scrap steel, and it is of this personal element that Mr. Alan Mulgan writes from Wellington. He needs no introduction to readers of the *New Zealand Geographer* for his literary work is as extensive as it is well known.

The fifth article in the series *Geography in Schools* has been presented in this issue by Mr. N. H. Whatman and Mr. C. M. Herbert, both of whom are Lecturers in Geography at Ardmore Teachers' College. They are here concerned with the development of geography in the primary schools of New Zealand.

Notes, commentaries and reviews in this number have been contributed by: Professor V. J. Chapman, Professor R. Piddington, Mr. W. H. Wallace, Mr. L. Curry, Mr. Bryan H. Farrell, Mr. W. J. Brockie and Mr. S. S. Cameron, all of Auckland University College; Mr. M. McCaskill of Canterbury University College; and the editors. Miss E. Banks has prepared the index for Volume 9 of the *New Zealand Geographer.*

NEW ZEALAND POWER: HYDROELECTRICITY. The *Annual Statement* for 1952-1953 of the State Hydro-Electricity Department and that of the Ministry of Works illustrate significantly the extensive works developments that are taking place throughout the country. In the two statements the generation of electric power provides a common theme.

During the year 1952-1953 government and supply authority power plants together generated 3,578,960,000 units, an increase of 116,661,000 over the previous year. Fifty-two percent of this increase took place in the South Island. The increase over the previous year was 5.1 percent in the South Island and only 2.4 percent in the North Island. These increases are smaller than those of previous years and were the result of restrictions and allocations in both islands. This position was eased a little in the North Island when Maraetai on the Waikato River went into partial operation in October 1952, and later in April 1953 when the island was freed of controls on power consumption.

A tremendous amount of construction and investigation took place during the year in direct response to the ever-growing demand for electricity. Important projects under construction were at Maraetai and Whakamaru on the Waikato and at Roxburgh on the Clutha. Major extensions were being undertaken at Waitaki and Cobb; lake control works to provide regulated storage were completed at Pukaki and continued at Waikaremoana and Tekapo, and thirteen substations were being built throughout New Zealand. By mid-1954 Maraetai, Waitaki, Cobb and Waipori should all be capable of producing more power.

Investigation in connection with future schemes was continued. Work was carried out at six sites along the Waikato between Karapiro and Taupo, and at Braeburn in the Murchison district where it is planned to use water from the Rotoroa lake. Investigations were undertaken at Benmore on the Waitaki River where a station as large as Roxburgh is planned, in the Kaituna River area, and at Lake Hawea where it is intended to install control works.

Reconnaissance surveys of potential power sites took place on the Waikato below Karapiro where engineers hope to use as much of the fall as is economically and technically feasible. Similar surveys were undertaken on the upper Rangitaiki River, at the lakes near Rotorua, in North Canterbury and Marlborough, and in the upper Waikato area. In this last area it is expected that 'a substantial block of power is likely to be available'. A similar plan is being prepared for the investigation of the southern lakes. This will include surveys of Te Anau, Manapouri, Monowai, Hauroko and Poteriteri.

Geothermal drilling continued at Wairakei where twelve shallow wells have already been bored. During the year deep-drilling machinery arrived from overseas, and since these annual reports were published other machinery able to withstand high temperature and pressure has been imported. Together this equipment has facilitated the boring of three deep holes. The third bore, over 3000 feet deep, blew-in in November 1953, and was the first well to discharge any dry steam. The finding of dry steam constitutes an important milestone in natural steam development. To use the wet steam previously found would be an expensive proposition entailing the use of separators and involving various technical problems, not the least of which is a loss of power. Work at Wairakei has reached a point where 'advice is now being sought from experienced overseas firms specialising in steam engineering to assist our own engineers in regard to the design and location of the first station to use geothermal steam. Associated with the investigation of geothermal steam for power development is the possibility of producing heavy water, and this is being examined in collaboration with the United Kingdom Government.' Decisions are still awaited concerning both these aspects. The first geothermal power plant will probably be rated at 20,000 kilowatts, and estimates of the power obtainable within the area range up to 70,000 kilowatts. It is however almost impossible to make any reasoned estimate of the amount of generating capacity that will be installed eventually in the seven square miles near Wairakei.*

Geothermal steam power is being used successfully at Lardarello in Italy to the extent of about 126,000 kilowatts of installed plant. Much has been written about the Italian scheme in connection with New Zealand developments. Although this method of electricity generation is spectacular, it should be remembered that steam in this area was first harnessed before the Lake Coleridge hydroelectric power station in this country was completed, and developments since that time have resulted in the present capacity at Lardarello being substantially less than at Arapuni, the second largest hydroelectric station in the dominion.

As well as the vast amount of work undertaken on power schemes as a result of increasing demand, supply authorities, in close touch with consumers, have been asked to investigate potential demand. The average rate of increase in consumption in the North Island over the past twenty-five years has been about ten percent per annum. The smaller increase this year may appear encouraging in some ways, yet it gives no indication of what the actual demand might be, freed of all restrictions or freed of the very real psychological check brought about by the thought that a ready supply of electricity might not be available when wanted.

In addition to reports on power development the *Ministry of Works Statement* contains accounts of surveys and construction, together with excellent sketch maps, of the developments on the Waikato, Waitaki and Clutha Rivers; and an outline in some detail of the departmental work entailed in the Tasman pulp and paper project. This includes the construction of a thirty-mile railway between Murupara and the mill site at Kawerau, a six-mile rail connection between Kawerau and the present main railway line, the restoration of a short branch of the main line at Mount Maunganui, the building of extensive marshalling and log-handling facilities at Murupara and Kawerau; wharf construction at Mount Maunganui, and the erection of two large townships at Murupara and Kawerau. The construction programme is scheduled to bring the pulp and paper project into production in 1955.—B. H. FARRELL

NEW ZEALAND POWER: COAL. In the two years since the serious industrial dispute of 1951 the coal-mining industry in New Zealand has made a rapid recovery. The vigorous working of opencast mines in the early months of 1951 saved the country's economy from the otherwise crippling effects of prolonged strikes in most of the larger underground mines. Within a few months of resuming regular working, supplies were back to normal and by 1952 it was apparent that an embarrassing surplus of slack coal was being produced on some coalfields. In 1952 coal production was back to the postwar average of 2,750,000 tons and all market requirements were satisfied without the need for importing high-cost coal from overseas.

The *Mines Statement* for 1953 shows that output per man employed in the industry was 540 tons in 1952, a figure exceeded only once before in 1945 when output reached

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* A fourth bore was blown late in February 1954, and a site on the left bank of the Waikato River half a mile north of Wairakei was chosen for the establishment of a geothermal steam power plant. Meanwhile it has been decided not to proceed with the heavy water project.
—Editorial note

570 tons per man. Output per man in underground mines has shown a steady fall since the record year of 1942 (530 tons) but the 1952 figure (408 tons compared with 320 tons in 1951 and 380 tons in 1950) suggests a rising trend again.

An outstanding role is now played by the opencast mines, and these have been chiefly responsible for the near-record figure of output per man for the mining industry as a whole. In 1951 about thirty-nine percent, and in 1952 thirty percent, of the dominion's coal supply was won by opencast methods. Developments and reserves in opencast mines are such that there is unlikely to be any serious coal shortage in New Zealand for the next twenty-five years at least. Opencast production has an important part in maintaining the relatively low price structure of New Zealand coals, and unless opencast output can be maintained at about one third of the total output an increase in the selling price of West Coast bituminous coals appears inevitable. Because of difficult physical conditions it is not possible to operate the larger West Coast underground mines at a profit under existing selling prices. The price to the consumer of bituminous coals for gasworks, railways and industry can be kept within reasonable limits only by balancing the loss on these mines by the substantial profits earned by opencast operations in many parts of the country, and by the less certain profits derived from some of the Southland and Waikato underground mines.

COAL PRODUCTION BY MAJOR FIELDS

Major Coalfields	Percentage of Total New Zealand Coal Production		
	1892	1922	1952
Waikato	9	23	36
West Coast, South Island	58	46	37
Otago and Southland	27	24	19
Others	6	7	8

The statistics of production by coalfields for 1952 show the continued increase, both relative and absolute, of the Waikato coalfields. Over the past sixty years an outstanding trend in the coal-mining industry has been the relative growth of Waikato production as compared with the West Coast and Otago and Southland fields. By 1952 the Waikato tonnage was almost equal to the West Coast output although a ton of Waikato subbituminous coal would yield only about three-quarters the calorific value of an average ton of West Coast coal.

To a country so long accustomed to coal shortages and lengthy delays in fulfilling orders, the sudden return to a condition of surplus may cause some surprise. The position is clearly revealed in the *Mines Statement* for 1953, which, for the first time in many years draws attention to problems relating to the marketing of coal and of competition with alternative sources of fuel and power.

Lignite producers in Southland, Otago and at Charleston on the West Coast have been the first to feel the chill winds of competition, as ample supplies of higher quality coals have been available even for the household market. Although total coal production increased by fifteen percent between 1951 and 1952 the output of lignite decreased by twenty percent. Of more serious consequence have been the difficulties experienced in marketing some bituminous coals which give a high proportion of slack coal on screening. At Garvey Creek, Reefton, a new bituminous coalfield has been opened up at considerable expense since the war in response to growing industrial demands for high-grade coal. Yet at the end of 1952 some forty percent of the year's output from this mine was not sold and lay in dumps in the Reefton railway yards. The marketing problem has also affected New Zealand's largest colliery at Stockton, on the Buller coalfield. This highly-volatile, strongly-coking bituminous coal has excellent steam-raising qualities but is rather high in sulphur content for gas making. Only one third of the Stockton output is lump coal suitable for railway locomotives, and the demand for unscreened and small coal has been reduced by the virtual cessation of coal burning in coastal steamers and by the growing use of oil fuel and electric power in industry. Because of the reduced output, eighty-one men at Stockton were retired in 1952 or were found employment in other coal-mining areas, while in 1953 the decision to close the Webb underground mine and to concentrate in future on opencast production has raised further employment problems in a district where there are few alternative occupations. The expansion of cement production in the dominion and the paper-pulp project at Kawerau may revive the demand for Stockton small coal. Briquetting has been considered, but in the opinion of the Department of Mines the very high cost of pitch binder rules out this method of utilisation at the present time.

The opening of the Maraetai hydroelectric power station and the favourable water-storage position in the North Island has proved embarrassing to the mining industry. The steam-generating electric-power stations at Wellington and Auckland have previously burned about 100,000 tons annually of slack coal from the Buller and Waikato but this market has been suddenly and severely restricted. Competition from imported oil fuel is also giving concern. In the past few years, especially since the strike of 1951, many industrial and commercial concerns and public buildings have replaced solid fuel heating plants with the more expensively operated oil-burning appliances. The *Mines Statement* emphasises that the supply of screened coal for railways and households depends on the ability to dispose of small coal. Before the war when New Zealand producers had to face competition from New South Wales mines, the wholesale dumping of unmarketable slack was practised. But to follow this course as a solution to present difficulties implies the destruction of a national resource and is the very antithesis of the policy of coal conservation of the past fifteen years.

On present-day prices coal firing is cheaper than oil firing and coal is still cheaper at the mine mouth in New Zealand than in New South Wales or Britain. It can be questioned whether the further displacement of coal and gas by electricity for such purposes as water heating and space heating is desirable on economic grounds. On a comparative cost basis, electricity is an inefficient method of supplying heat. If the most economical use is to be made of New Zealand's coal and hydroelectric power resources, and of the overseas funds used for importing furnace oil, it would seem imperative that a much closer coordination be attained between the several departments of state concerned with the production, distribution and control of the different forms of energy.—MURRAY McCASKILL

TRANSTASMAN AIRLINE OPERATIONS. The statutory obligations of government-owned airlines in New Zealand demand that they should provide air services to meet the requirements of the dominion. In terms of the limited potential traffic the central problem has not been to make ends meet, but to reduce losses to a minimum. In point of fact both NAC and TEAL have shown favourable balances on occasions, though the prolonged shipping strike from February to July 1951 materially aided both corporations for two financial years at least. While NAC showed a small operating profit for 1952-1953, TEAL suffered a considerable loss, estimated at £180,000, forty-four percent of which was incurred on the 'Coral Route'.

TEAL, an international airline, not only operates the strictly commercial transtasman and Fijian services, but also, in the national interest, it is required to fly the uneconomic southwest Pacific services which proved such a costly experiment with NAC. Although the 'Coral Route' has considerable potentialities for tourist traffic, at present the stages east of Fiji are largely based on the administrative and humanitarian requirements of New Zealand's island territories, with the extension to Tahiti designed to tap the tourist trade of another island otherwise omitted from the world's air routes.

While NAC is effectively subsidised by the provision of airfields from public loans and grants, TEAL is required to meet all its overheads from operating profits. That it has managed to keep these costs to a minimum is largely due to the fact that over ninety percent of its services have been carried out by flying boats. With the continued emphasis on the development of the landplane as opposed to the flying boat, and on the provision of airfields of international standards near all the main cities, it may well be that the pendulum will swing in favour of landplane operation. Indeed it was reported late in 1953 that TEAL would be flying modern landplanes on all but the Coral Route in 1954.

The reasons for this change are several. Operating from first-class aerodromes on the transtasman services, the new aircraft will offer greater reliability and safety from high-altitude 'over the weather' flying on a route that is comparable only to the North Atlantic in terms of adverse meteorological conditions. Traffic receipts should also benefit from the greater economy of operation that can be expected from the more modern machines. This will show most markedly in the avoidance of the practice of reducing the payload on westbound flights, particularly in winter when considerable headwinds are invariably encountered. Schedules, however, will not materially improve as the flying boats have been able to fly from city centre to city centre and by so doing have avoided the time-consuming surface transportation from aerodrome to city.

In the Pacific, on the other hand, the infinite number of stretches of water suitable for alighting will permit the flying boat to retain its flexibility and economy of operation in a region where airfields capable of accepting modern high-performance airliners are impracticable for economic, social or locational reasons.—W. J. BROCKIE

M.A. AND M.Sc. THESES. During 1952 and 1953 twenty-two theses were presented by students seeking masters degrees in the University of New Zealand. The titles illustrate a noteworthy trend in postgraduate work in the constituent colleges of the university—namely the greater emphasis on topics wider than the small regional study. The investigation and interpretation of the geographic character of a small area, once so popular as a thesis topic, has its place in regional geography, particularly as an integral part of fieldwork studies in the Stage III course on New Zealand. For this reason, then, the greater number of theses dealing with particular aspects of systematic geography, many of them dominion-wide in scope, is to be welcomed, and is indicative of a growing maturity in postgraduate studies. There does remain a place for regional study *per se* at the postgraduate level, for much has yet to be done in the determination of the geographic character of distinctive areas in New Zealand—but such investigations should be wider than those based on a single town and its tributary area.

The theses presented in 1952 were as follows—

From Auckland University College:

Rural Villages of Otamatea, Rodney and Waitemata Counties: A Study in the Geography of Rural Settlement, A. G. Anderson;
A Geographical Study of New Zealand's Internal Air Services, 1950-1951, F. H. Bishop;
Transport in North Auckland: An Essay in Comparative Historical Geography, B. A. Webster;
Tauranga and Whakatane: A Contribution to the Geography of New Zealand Ports, R. A. Wright.

From Canterbury University College:

Stock Water Races in Ashburton County, B. W. Leadley;
The Contemporary Geography of Exotic Trees in Canterbury, S. L. Hale.

From the University of Otago:

Invercargill, Its Past and Present Character, J. W. Anderson;
The Ports of Bluff and Otago, A. E. Tarrant.

In 1953 fourteen theses were presented—

From Auckland University College:

Industrial Penrose, 1951-1952: A Study in the Geography of Manufacturing, H. G. Bawden;
A Geographical Study of New Zealand Basic Chemical Industries, K. R. Buckley;
Manufacturing in Lower Hutt and Petone, G. J. Dewhurst;
Pioneer Fringes in Southern New Zealand, K. G. Dobbie;
A Geographical Study of the External Civil Aviation of New Zealand, 1951-1952, R. D. Mayhill;
The Significance of Coastal Shipping in the Economic Development of Northern New Zealand, M. O. Nicholas;
The Pastoral Fringe in Hawkes Bay, P. N. D. Pirie;
The Interdependence of Upland and Lowland in Taranaki, R. D. Stanley.

From Canterbury University College:

Land Use on the Moutere Gravels, Nelson, H. B. Bourne-Webb;
Commercial Dairy Farming in the North Canterbury Land District, P. Marshall;
The Impact of Gold Mining on the Landscape and Economy of Central Otago, G. P. Mitchell;
A Description and Interpretation of Some South Island Railway Patterns, V. Preece;
Plant Geography of Castle Hill Basin, D. H. Relph;
Land Use Changes in the Rakaia Hinterland, P. J. Smith.

Other theses from Canterbury University College were presented after 1 November 1953 by students who were examined for their degrees in that year. The titles of these theses will be recorded at a later date.

ADDITIONS TO THE MAP LIBRARY. During the past six months twenty-six new maps have been filed in the library of the New Zealand Geographical Society. Four are part of the series N.Z.M.S. 1 on a scale of 1 : 63,360—Tarawera (N. 77), Hutt (N. 160), Onoke (N. 165) and Palliser (N. 168-169). Unfortunately the last two rely entirely upon spot heights to indicate altitude, though some appreciation of the broken nature of the country may be gained from close study of the drainage patterns. It is this very ruggedness, of course, that has precluded ground survey. The Hutt Sheet is a first edition and replaces the previous provisional publication.

In the series N.Z.M.S. 2 on a scale of 1 : 25,000 eleven maps have recently been published, seven of them covering the Lovells Flat-Balclutha area in Otago. These are: Lovells Flat (S. 171/9), Akatore (S. 172/5), Tokoiti (S. 172/7), Glenledi (S. 172/8), Balclutha (S. 179/3), Romahapa and Coal Point (S. 179/6-180/4) and Wangaloa (S. 180/1). The four remaining maps are reductions of the four-inch series N.Z.M.S. 86 and depict vividly the 'emptiness' of the Volcanic Plateau between Mokai and Taupo. Mauiui (N. 93/2), Mokai (N. 93/3), Rama (N. 93/5) and Marotiri (N. 93/6) are excellent maps, worthy forerunners, it is hoped, of other medium-scale maps of this little-known heart of the North Island.

N.Z.M.S. 19 is a series of seven topographic maps on the scale of 1 : 500,000 which give a complete cover of New Zealand, whilst in the series N.Z.M.S. 17 three new street maps have been issued: Christchurch, New Plymouth and Gisborne. The final map is one of the air route between the United Kingdom and New Zealand flown during the recent air race to Christchurch. Cartographically the map is interesting—it is drawn on an oblique mercator projection with a constant scale axis 1 : 12,000,000 along a great circle—but its usefulness is not apparent and will be confined to aviation circles.

IN OUR CONTEMPORARIES

In Overseas Journals . . .

The Shifting Geopolitical Balance in the Pacific

THE ANZAC DILEMMA: F. L. W. Wood, *International Affairs,* Vol. 29, No. 2, April, 1953, pp. 184-192.

NEW ZEALAND AND THE NEW PACIFIC: L. K. Munro, *Foreign Affairs,* Vol. 31, No. 4, July 1953, pp. 634-647.

It has often been claimed that parochialism is a characteristic of New Zealanders, for even if their interests do extend beyond the limits of their 'provincial' areas, they have paid little attention to the world at large. Many would suggest that this undue concentration on domestic affairs is the product of isolation and complacency. Certainly Australia is 1200 miles distant and the rest of the world much further, and life in New Zealand has much to recommend it. Moreover, a 'small nation' attitude of mind has developed, fostered by the realisation that somewhere in the background stood the might of Britain and the British Commonwealth of Nations. This reliance on a mother country half the world away has always been cardinal in the geopolitical thinking of the average New Zealander, and from it originated much of his self-satisfaction and his feeling of security. For not only was Britain the source of military and naval power; there too lay the market for the dominion's dairy produce, meat and wool, and thence came much of the capital for the country's development.

Today, however, the geopolitical balance is shifting and, as Professor Wood shows, Australia and New Zealand are faced with a dilemma. The incursion of the Japanese into the southern Pacific in 1942, the inability of Britain to extend her forces beyond Burma, and the deployment of American military, naval and air power across the Pacific shattered traditional strategic concepts. The 'Far East' mentality of the inter-war years was replaced almost overnight by the realisation that there was a 'Near North' and that the British dominions of the southwest Pacific had now to look to their own defence.

The logical outcome was the Anzus Treaty of 1 September 1951, for neither Australia nor New Zealand could stand alone against offensive action by Asiatic powers. Britain, committed in the European sphere and saddled with her own economic problems, obviously could not—and still cannot—be considered as effective in Pacific strategic planning. The United States had to take her place, and from the viewpoint of the British Dominions this was highly desirable since it was the United States who, in effect, had called in Japan to redress the balance of power in Eastern Asia. The notion that the U.S.S.R. and Communist China were now the *bête noire* in the Pacific world instead of Japan might appeal to Americans, but both Australians and New Zealanders required more than assurances on this point. Professor Wood suggests that in any Pacific war, as in 1942-1945, they would run the primary risks since only the western fringe of the United States would be touched. Strategic concepts of transarctic warfare have profoundly modified this view, although the basic problems of Australian and New Zealand security remain.

Hence the dilemma. Today Australia and New Zealand must look to the United States for support in the Pacific and yet they are closely tied economically with Britain. Tradition, too, strongly influences any governmental decision in these two dominions although there is not always agreement with British policy—witness New Zealand's persistence in the recognition of Nationalist China. Nevertheless it seems that Britain is prepared to withdraw from the Pacific realm even further and to allow the dominions more and more to take her place. The recent reorganisation of Pacific air routes would suggest this. Thus New Zealand is adopting a realistic attitude to conditions in the 'New Pacific' and this, as Mr. Munro indicates, is really a climactic development of policies advocated since 1884 which aimed at making New Zealanders the 'custodians of the British imperial tradition in the South Seas'.

It may be argued, with some truth, that domestically New Zealand has exhibited little care for this custodianship and that the average citizen is hardly aware of the nature and extent of the dominion's responsibilities in the Pacific. Australia, with her interests confined mainly to New Guinea, is hardly better placed to argue that she has full cognisance of her duties, although of course both she and New Zealand are members of the South Pacific Commission. Mr. Munro emphasises the part New Zealand has played in the formulation and the putting into effect of the Colombo Plan, and sees in this a forward step in the organisation of security in the Pacific. Others are the strengthening of defences by regional pacts conformable with the spirit of the United Nations, and the preparedness to fight if necessary.

In this last respect, New Zealand has always regarded the Middle East as her particular theatre of operations, since for her the vulnerability of the Suez Canal and sea communications has bulked large in strategic considerations. Moreover, in a world war the fate of the dominion could well be decided in this area, and the presence today of a R.N.Z.A.F. squadron in Cyprus suggests that this aspect of British Commonwealth strategy is just as significant as it ever was.

The Anzus Treaty, by securing the home base, will permit New Zealand to deploy her forces and to maintain her traditional role in the Middle East, if necessary. Thus as long as Britain and the United States are in agreement and as long as Australia and New Zealand have a voice in the formulation of policies, strategic planning need not be at a variance with tradition. But both Australia and New Zealand must be prepared to stand in Britain's place in the Pacific, shouldering her burdens, and thereby offer to the mother country some semblance of that security which she so freely gave to the dominions in the past.

REVIEWS

For the Farmer—and Others

THE PRINCIPLES AND PRACTICE OF ANIMAL NUTRITION. By I. E. Coop. Wellington: Technical Correspondence School, 1949, pp. 126.

ARABLE FARMING IN NEW ZEALAND. By R. H. Bevin. Wellington: Technical Correspondence School, 1951, pp. 104.

GRASSLANDS OF NEW ZEALAND. By E. Bruce Levy. Wellington: Technical Correspondence School, 1951, pp. 344.

These three books, written by recognised experts for student and practising farmers, have been published as textbooks by the Technical Correspondence School of the Department of Education. Since they deal mainly with practical management problems and the scientific background to such problems, their appeal will be limited, but to geographers interested in the agricultural geography of New Zealand they are extremely useful.

In *The Principles and Practice of Animal Nutrition* Professor I. E. Coop surveys the components of food—carbohydrates, fats, proteins, minerals, vitamins and water—outlining their respective sources and functions for the animal. After an initial discussion of the digestion and use of these food components and of the standards used in measuring food values, he goes on to analyse individually each type of roughage, succulent and concentrate. Because of the importance of grassland farming in New Zealand, pasture production and use are examined in detail, particular reference being made to seasonal variation. Finally, maintenance and production requirements of food for cattle, sheep, pigs, horses and poultry are given, attention again being paid to seasonal variation and to the problems encountered in different types of farming systems.

In attempting to lay down broad principles for the management of arable farms in New Zealand, Mr. Bevin faces the problem of covering regional and individual variations on a main theme as well as on all phases of farm work from pasture establishment to types of machinery and budgeting. It is impossible to deal adequately with all these aspects in this slim volume, *Arable Farming in New Zealand*. Consequently, a balanced cropping and sheep farm of 300 acres is chosen for close study, although other types of farms are surveyed more generally.

The classification of arable-farm types adopted by Mr. Bevin could well serve as a basis for a subdivision of the commercial crop and livestock farming areas designated by Dr. Kenneth B. Cumberland. (See *Geog. Journ.*, Vol. 112, Nos. 1-3, July-Sept. 1948, pp. 58-60.) These arable farms are grouped as follows: (1) intensive arable cash crops dominant; (2) medium intensive arable: balanced cropping and sheep; (3) medium intensive arable: sheep dominant; (4) extensive arable: sheep with wheat; (5) extensive arable: sheep dominant.

In his *Grasslands of New Zealand* Sir Bruce Levy summarises his vast experience of New Zealand grasslands, and few people could present the whole gamut of pasture ecology, development and management with such authority and clarity as this former Director of the Grasslands Division of the New Zealand Department of Scientific and Industrial Research.

The first chapter surveys the ecological regions of New Zealand, paying particular attention to the pasture constituents. This affords a useful comparison with a similar survey by P. D. Sears (*N.Z. Geographer*, Vol. 1, No. 1, pp. 57-82). In subsequent chapters the author compares animal raising in this country with that in Europe and North America; discusses pastures on the basis of the time that they are down and their productivity; and gives a brief introduction to grass ecology, pointing to the most important environmental factors involved—soil fertility, soil moisture, temperature, and light and shade. Grasses are classified from the point of view of their growth form, seasonal response and palatability. Other chapters cover the purpose of plant breeding; the establishment and management of grasslands; the results of recent research on intensive grassland management; practices for bringing-in forest and scrub country; recent work on soil conservation; seed selection; and weed control.

On reading this book, one is struck by Sir Bruce's intensely practical nature. An efficiently-run grassland farm involves a series of complex operations, many of which are little understood, but which the author seeks at all times to reduce to rules of thumb. The more scientifically inclined may tend to rebel at this reliance on empiricism but the answer can only be found in more research. From this reviewer's point of view the most glaring gap in our knowledge concerns the precise influence of climate. Time and again, Sir Bruce concludes that climate is the most important influence on the management and use of pastures, and yet it is clear that these relationships are not understood. Table III (p. 119), for example, shows that half the common grasses of New Zealand, including ryegrass, are not tolerant of sunny conditions. Again, another table shows *Poa maniototo,* a residual tussock species in the drier parts of Central Otago, as tolerating only dry soils. These statements seem fantastic. Another table showing seasonal growth of the different grasses must also contain many inaccuracies since it is not specific as to place and climate. Italian ryegrass, for instance, will surely show good response in summer and early autumn if moisture conditions are right.

A rather important point concerning climate relates to the author's arguments on the relative merits of either breeding plants within the climatic area where they are to be used or selecting them in a single highly favourable environment. Although he mentions that separate breeding points must be established in each of the world major climatic zones, he appears to regard New Zealand so sufficiently homogeneous that a single breeding station at Palmerston North will serve. While this may be true in general, it must make very difficult selection of drought-resistant varieties of the better producing grass, to take but one example.

When, in his last chapter, Sir Bruce puts into print his thoughts on the proper role of agriculture in a national economy he has moved far from his own field. Here he uses methods which he would condemn in ecological research, and sometimes he comes close to special pleading. A call for a world-wide adjustment of incomes in favour of farmers sounds strange in 1953. To use the relative decline of agricultural and nonagricultural prices during the interwar slumps as an argument without mentioning the unemployment situation is distinctly misleading. Finally, the contention that country life produces more leaders and better physical standards than life in the town could surely well remain in the limbo into which it has passed.

—L. CURRY

The Lure of Gold

PROSPECTING FOR GOLD. By W. F. Heinz. Christchurch: The Pegasus Press, 1952, pp. 56.

There is gold still to be found in New Zealand. Although few people are likely to make much of a living from it the amateur prospector may yet find in the stream beds of Westland and Otago sufficient gold to make a worthwhile summer holiday or a novel form of family picnic. *Prospecting for Gold* is a further contribution to the series of attractively-produced but inexpensive *New Zealand Holiday Guides* published by the Pegasus Press. Mr. Heinz deals mainly with Westland, where he has had long experience as a gold prospector, but the methods he describes can be readily applied in Otago.

The book illustrates with the aid of simple diagrams the equipment and methods the amateur prospector will use: the gold pan, the rocker or cradle, and the sluice box—indeed the same simple equipment used by thousands of miners in the first few years of the gold rushes of the 1860's. There is a description of the more elaborate methods such as hydraulic sluicing, paddocking and elevating which were used in later years to work low-grade alluvial deposits. This is of more than historical interest, ~~for it~~ was as a result of these methods that the old alluvial miner left his greatest impress on the present landscape. A concise thumbnail sketch of the history of the Westland goldrush follows, together with an account of the origin of alluvial gold and its mode of occurrence, and some tips on likely places to look for it. Other sections include a lively summary of the activities of Chinese miners in Westland, and a brief statement on mining law as it applies to prospectors for alluvial gold. The book concludes with a brief bibliography and a glossary of gold-mining terms, interpreting for the amateur such intriguing words as 'winze', 'bottom', 'hatter', 'hanging wall', 'long tom', 'puddling', 'riffle' and 'stope'. Thirteen half-tone illustrations add interest to the book, while a three-page map on a scale of four miles to one inch depicts for would-be prospectors the main alluvial goldfield of Westland—a narrow belt of country, about five miles wide, extending from Ross to Reefton.

Perhaps Mr. Heinz could have added a word of warning to the enthusiastic amateur who may try his luck in the heavily-forested terrace country of Westland. Some old gold-mining areas are riddled with abandoned shafts as much as eighty feet deep and obscured by second-growth bush. These shafts have proved death traps to the unwary.

—Murray McCaskill

Monarch of the Bush

THE STORY OF THE KAURI. By A. H. Reed. Wellington: A. H. and A. W. Reed, 1953, pp. 439.

The Story of the Kauri is the work of an enthusiast whose profession has for fifty years kept him remote from the object of his enthusiasm, but now an extremely fortunate coincidence has enabled him to write and publish this book about it. Here is the first real attempt to portray in its totality the vanished kingdom of the kauri.

Bleached stumps, burned-out ghosts of trees, overgrown sawdust heaps, derelict shanties and scarred gumfields were the principal features hitherto available as evidence in the reconstruction of the past scene in Northland and Coromandel, but now with

The Story of the Kauri the forest stands again in full vigour to fall before axe and fire, to be sweated over and sworn at by bushmen and bullock drivers. The story is told at all levels—from that of the millionaire sawmilling combines down through the efforts of the small millers and contractors to the parts played by the cooks, the crosscutters, the climbers and the 'skiddies'. All this diverse material is subtly interwoven to give a balanced picture of this so recent yet so irrevocably vanished era. It is patent that Mr. Reed, whilst admiring the men whose very industry condemned the kauri, is acutely aware of the criminal folly of the whole business. He maintains this objective attitude, so rare in an enthusiast, right through to present-day controversies.

Any degree of smooth continuity that the narrative may lack is counterbalanced by photographs. As a supplement of 130 pages they are abundant, seldom irrelevant, and most, particularly those provided by Tudor Collins, repay the closest study.

Scattered throughout the text are line sketches. Some convey very neatly the atmosphere of the kauri forest, some elucidate technical points, but many are redundant (for example, the point of the sketch on page 196 is much more effectively conveyed by the lower photograph on page 382). Some are completely out of character (p. 198) and would do little to speed the pulse of an old kauri bushman, but others, notably those of Syd Scales do ring true.

One serious criticism must be faced. On pages 264 and 265 there is a neat and moderately informative map of the Waipoua forest area. On page 353 there is a technically interesting facsimile of a small part of an old cruise map. But nowhere is there a map, or maps, to show the range of the kauri in its heydey, its limited extent today, or to pinpoint the localities so colourfully described. It is to be hoped that when this limited first edition is reprinted these essential maps will be included.

However, nothing can obscure the fact that *The Story of the Kauri* rescues from threatened oblivion an important phase in the development of New Zealand. It is an exposition of a way of life which dominated Northland, but it never shirks the tragedy of the plunder and mining of the finest and largest-yielding timber tree the world has known. It will fascinate the forester, provide background reading for the geographer and the historian, and let the layman see in true perspective the role of the kauri. It reinforces the hope that some means will yet be found to restore the kauri as part of the official insignia of the New Zealand Forest Service, for it has now been largely ousted by an unromantic exotic.—S. S. Cameron

An Anthropological Stocktaking

SOCIAL ANTHROPOLOGY IN POLYNESIA: A REVIEW OF RESEARCH. By Felix M. Keesing. Melbourne: Oxford University Press 1953, pp. 126.

To the task of writing this book Professor Keesing brings an unrivalled knowledge of past and present conditions in the central Pacific, a gift for succinct expression, and a flair for organising material in a systematic manner. To his statement of results so far achieved and of problems still to be studied are added copious bibliographical references. The book is thus both a means of ascertaining what has been done and a charter for future research in the field of applied anthropology with which it is concerned.

The author begins by stressing the relevance of social anthropology to problems of native welfare and the way in which this has been recognised by governments in other parts of the world. In this respect administration in Polynesia appears to lag behind, partly owing to the antiquarian emphasis of much of the research which has been done in this field. Research has been largely remote from practical problems and many administrators and officials tend to think of anthropology in terms of *Kon Tiki*. Professor Keesing's book will be a valuable corrective to this tendency. He shows how in the many fields covered by the terms economic development, social development and health, the anthropologist can play a vital part in cooperating with technical experts and making available to them his specialist knowledge of what is the most vital factor in any welfare problem—the human beings concerned.

At the present time the technological and scientific resources of Western civilisations must be made available to underdeveloped areas such as the central Pacific, and the South Pacific Commission is one of the international agencies through which this is being achieved. The policy is dictated alike by humanitarian considerations and by political and international pressures. Unfortunately in practice it is too often based on the assumption, implicit rather than explicit, that material development will of itself achieve the improvement in native welfare which everyone would like to see. Indigenous forms of social usage and value systems, so far as they impede or resist the onward march of material progress, are regarded as manifestations of irrational conservatism or 'superstition'. If only, it is implied, there can be injected enough capital, enough schools built and sufficiently large doses of 'technical assistance' given, all will come right in the end. The attitude is not unlike that of the early missionaries who thought that spiritual salvation was the answer to all the social problems of backward areas. The results emerging from it are also likely to be similar, because manifestations of 'conservatism' and 'superstition' are reflections of the fact that indigenous cultures are vital adaptive mechanisms. They provide for those to whom they belong certain satisfactions and forms of psychological security lacking in modern civilisation and even more lacking in the uneasy condition of transition which prevail and must continue to prevail for many years to come. For this reason, they will not readily be abandoned.

The first duty of the anthropologist is thus to show how measures designed to promote material welfare must take into account the human realities of the situation. Professor Keesing illustrates this generalisation by a wealth of references to detailed practical problems.

Some anthropologists may regret that Professor Keesing makes no reference to what might be regarded as the more general and fundamental task of applied anthropology. It is agreed that the anthropologist should help to prevent technical experts from making blunders through ignoring the vital human factors in the situation. But in what spirit should he do this? Should he subscribe to the view that native ways of life are powerful but wholly undesirable obstacles to the goal of making indigenous peoples like ourselves in all respects, of turning them culturally into brown Europeans or Americans as soon as possible? Or should he emphasise the positive satisfactions which indigenous ways of life provide, even under conditions of 'detribalisation', as giving them a value in their own right? Should he even suggest that material development might even be 'soft-pedalled' in certain limited fields in the interests of social and psychological integration? An affirmative answer to the last two questions would be regarded by the high priests of 'technical development' as a form of heresy, implying as it does a challenge to what might be called the New Imperialism—an imperialism of ideas and values which is no less arrogant because it is internationally and altruistically conceived.

However this is an issue which is more relevant to political development (which is explicitly excluded from the terms of reference of the South Pacific Commission) than to the social and economic problems with which Professor Keesing is concerned. And perhaps his persuasive and allusive approach will in the long run do more than plain speaking to promote the anthropological approach to alien cultures. In any case, this book is a major contribution which should be read by all those interested in the welfare of Pacific peoples, and particularly those who are concerned with policy decisions on scientific research in this area.—Ralph Piddington

The Pacific World

AUSTRALIEN UND OZEANIEN. By Hans-Joachim Krug. Berlin: Walter de Gruyter & Co., 1953, pp. 176.

AUSTRALIA, NEW ZEALAND AND THE PACIFIC ISLANDS. Edited by E. D. Laborde. London: William Heinemann Ltd., Second edition 1952, pp. 268.

Australien und Ozeanien is a vest-pocket reference designed for the general reader. It is one of 300-odd little booklets in the series *Sammlung Göschen,* only two of which are geography books. Of its 176 very small pages, twenty are devoted to an introduction and to the history of Pacific discovery. Australia receives sixty, and the 'island world' the rest. New Zealand is awarded fifteen pages of type so small as to be a strain on the eyes, and five diminutive maps. The text is brief but statistics are up to date. The information presented and the conclusions reached are much better than would be suggested by the map of land utilisation which links together both the Waikato and all the South Island high country as constituting 'good meadowland', or by the bibliography which contains only four titles with reference to New Zealand. These are a strange assortment: Bell, *The Wilds of Maoriland* (1914); Dieffenbach, *Travels in New Zealand* (1843); Douglas, *The Dominium* [sic] *of New Zealand* (1909); and Cumberland, *Canterbury Landscapes* (1940).

The foreword to Heinemann's school textbook on the Pacific—the only textbook at this level and with this particular areal coverage known to the reviewer to be in print in 1953—claims that this edition 'has been completely revised and brought up to date'. It is an interesting, if not very rewarding, exercise to compare the pages of the first and second editions. There has been very little rewriting. Here and there occasional sentences, which today would be laughable if retained, have been omitted and a similar number of words inserted without disturbing other lines on the page. It is doubtful whether such rare and economical emendations of the text qualify as 'complete revision'. Some statistics have been changed, though they are still five to ten years out of date compared with those of the little German reference book. For example, in the one the population of New Zealand is 'today' 1,834,000 (p. 189); in the other it is 2,023,928.

Laborde and his coauthors have written in Britain for British schools. Their book lacks firsthand knowledge of the Pacific and reveals the authors' dependence on other sources. In the absence of source material written by geographers they have had to rely on a variety of works of special interest and also on popular travel accounts. They also touch on many aspects of Australia and New Zealand—history, social institutions, governmental organisation, art and literature—which a reader in these countries will find unnecessary, if not rather tedious and superficial, and their relevance he will find difficult to understand when so much of the geography of Australia, New Zealand and the island territories is barely hinted at. But until some Australian or New Zealand geographer writes a better book, and one better illustrated, for the same purpose and covering the same part of the world, this one will remain of some value in the library of Australian and New Zealand schools. It cannot be recommended as a class textbook.

The Story of the Gulf Stream

THE OCEAN RIVER. By H. Chapin and F. G. Walton Smith. London: Gollancz, 1953, pp. 325.

The Ocean River—Oceanus of the Ancients—is the Gulf Stream, that great flow of warm water which originates in the Caribbean and sweeps across the Atlantic until it reaches and warms the shores of northern Europe, giving these lands a climate much more favourable than it otherwise would be. In this book are combined the work of an historian and anthropologist (Mr. Chapin) and an oceanographer and marine biologist (Dr. Smith). The book is not intended solely for the professional historians or oceanographers, since it is written in language that is readily intelligible to the layman.

The first chapter summarises the history, the forces, and what are called the 'unanswered mysteries' of the Gulf Stream. Then properly, in order to understand the Atlantic, there is a chapter devoted to the birth and history of the earth, with a summary of ideas about past land masses. The next chapter, which to the reviewer appears to be the only possibly irrelevant chapter, deals with evolution and the development of aquatic organisms, though of course it is true that the existing denizens of the Gulf Stream are better understood if something is known about their past.

The next three chapters are really fascinating, not only to the scientist but to the general reader. They deal with the legendary continent of Atlantis, the first essays of Europeans to sail out into the westward seas towards the setting sun, and, after the discovery of the Americas, with the efforts of navigators to chart the course of the Gulf Stream.

Two more chapters are devoted to a discussion of the basic causes underlying the Gulf Stream—what one may call the nature of the stream. Here the authors find themselves ultimately discussing the atmosphere and the evidence for recent changes, which suggest that Europe is steadily becoming warmer and its climates more equable.

The remaining chapters are devoted to the Gulf Stream insofar as it is related to man and his activities. There is the story of the fisheries, including the story of the eels, the history of the great cod fisheries on the borders of the stream, the quest for treasure in the West Indies and Mexico, and finally the story of sail, crack ocean liner and jet plane as means of traversing the Atlantic and the Ocean River.

This book, as one can see, covers a number of disciplines, and yet all are essential for a thorough understanding of a phenomenon such as the Gulf Stream. The combination of authorship is a happy one, and when the book has been read one is left wishing for more such combinations that can tell a scientific story in an intelligible manner. The debt to the present authors is all the more because they have attempted to explain the very latest relevant hypotheses, so that although the book is written in popular language, it is nevertheless scientifically and historically up to date.

—V. J. Chapman

Postscript

On a previous page Mr. Alan Mulgan mentions 'engineering difficulties and their surmounting, and . . . problems of maintenance' and 'the unstable character of the high country' as he describes the railways of New Zealand. The recent disaster at Tangiwai serves to emphasise these points, and Mr. S. S. Cameron, Junior Lecturer in Geography at Auckland University College, makes these comments:

From Ruapehu, the highest mountain of the Tongariro National Park group in central North Island, many laterally extensive mudflows of the lahar type have issued in past geological times and have left their traces in widespread hummocky conglomerate fields and massive erratics; but within historical time no broad-front lahars of volcanic origin have been observed.

Shortly after 8 p.m. on Christmas Eve 1953, Crater Lake, 8400 feet high on the summit of Mt. Ruapehu, released an initial twelve million cubic feet of water which bore down the upper course of the Wangaehu River with a load of debris at an average rate of twelve miles per hour. By 10.15 p.m. it had reached Tangiwai, 6000 feet below, where the main Auckland-Wellington railway line crosses the normally insignificant river. At 10.21 p.m. the locomotive and leading six carriages of the northbound express plunged at speed into the ice, silt and rock-laden flow and took over 120 people to a swift death.

Instrument readings taken at the nearby Chateau Tongariro discount seismic or volcanic activity but tend to the theory that the ultimate stage of some cumulative process enlarged the subglacial tunnel by which the waters of the lake normally entered the Wangaehu River. Although this recent wave is the largest, several have previously descended this same river over past decades and there is no reason to suppose that the process will not be repeated. Accordingly a routine aerial patrol will henceforth photograph the level of the Crater Lake and automatic flood-warning devices are to be installed on the Wangaehu River. Whether the engineering expedient of artificially maintaining the lake at a low level, as is done at Keloet in Java, may ultimately be resorted to, is as yet matter for conjecture. At any rate such a tragedy must not occur again.

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The New Zealand Geographical Society was founded officially in Wellington towards the end of 1944. Its real foundation, however, took place in Christchurch in 1939 when a group of enthusiasts formed what is now the Canterbury Branch of the Society. Their lead was followed in February 1944 in Wellington, and further branches came into being in Auckland and Dunedin early in 1945.

The aims of the Society as stated in the constitution are 'to promote and stimulate the study of geography'. These are the aims of more than one Society in the world and the New Zealand Geographical Society is particularly concerned with geography in New Zealand. It is therefore the Society's policy to stimulate geographic studies of New Zealand and matters closely related to the Dominion.

The Society undertakes the publication of a journal, the *New Zealand Geographer*, and of a *Record* of its proceedings, both of which at present appear twice a year. Branches of the Society organise lectures, study groups, and excursions, and encourage their members to prepare matter for publication in the *New Zealand Geographer*. Contributions from overseas writers and those who are not members of the Society are also encouraged.

Membership of the Society is open to all persons interested in the aims of the Society. Full details of membership will be sent on request by the Secretary, New Zealand Geographical Society, Department of Geography, Canterbury University College, Christchurch, C.1.

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